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LOGISTIC REQUIREMENTS AND CAPABILITIES FOR RESPONSE TO OIL POLLUTION IN ALASKA

P. L. Peterson, et al

Battelle Pacific Northwest Laboratories

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LOGISTIC REQUIREMENTS AND CAPABILITIES FOR RESPONSE TO OIL POLLUTION IN ALASKA

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MARCH 1975

FINAL REPORT

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DEPARTMENT OF TRANSPORTATION
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16. Abstract

This report identifies present and projected logistic support requirements for response to oil spills in the arctic and sub-arctic regions of Alaska. Area response is based on estimates of the most probable course of petroleum development within the state. The present logistic support capability of the U.S. Coast Guard, military organizations, other federal agencies and private industry is identified and compared to future response requirements.

A set of guidelines was used to assess the response requirements in various environmental settings (moving pack ice, open water, tundra, etc.). The guidelines included the number of personnel and amount of equipment to be transported, time on scene, and initial response time. Fourteen selected sites were evaluated. It was concluded that the present Coast Guard logistic support capability will have to be supplemented as oil production expands throughout Alaska. The major areas of deficiency in future response logistics are expected to be initial response time and field support for extended periods in remote areas.

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FINAL REPORT

LOGISTIC REQUIREMENTS AND CAPABILITIES FOR RESPONSE TO OIL POLLUTION IN ALASKA

TO

UNITED STATES COAST GUARD
WASHINGTON, DC
CONTRACT DOT-CG-23223-A
TASK 14

March 1975

W. H. Swift
Project Manager

PACIFIC NORTHWEST LABORATORIES
A division of
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RICHLAND, WASHINGTON 99352

PREFACE AND ACKNOWLEDGEMENTS

This report has been prepared for the United States Coast Guard to provide an assessment of present logistic support capability and future requirements to supplement response capability to selected locations within Alaska.

The report was prepared under Contract DOT-CG-23223-A to the Columbus Laboratories of the Battelle Memorial Institute. The work was performed by the Pacific Northwest Laboratories of the Battelle Memorial Institute. Battelle-Northwest participants in the study include: W. V. Loscutoff, transportation elements; M. M. Orgill, climatological review; P. L. Peterson, field support requirements, logistic system elements, and response analysis. W. H. Swift served as program manager.

In conducting the study, Battelle-Northwest has drawn heavily upon information provided by industry, government, and Coast Guard sources gained either by field interviews or correspondence. The following individuals or organizations were particularly helpful: LCDR Leon Clarizio and CDR K. R. Kellogg, U.S. Coast Guard - Juneau; CAPT H. C. Lyons, U.S. Coast Guard - Anchorage; CDR R. T. Martin, U.S. Coast Guard - Kodiak; LT James O'Brian, U.S. Coast Guard Pacific Strike Team; LT James Getman, U.S. Coast Guard Research Office, Washington, DC: Dr. Warren Denner, Director of Naval Arctic Research Laboratory; Jim Dalton, Naval Petroleum Reserve Office in Barrow, Alaska; William Hopkins, Alaska Oil and Gas Association; COL W. J. Huxley and COL C. M. Adams of Alaska Command, Elmendorf Air Force Base; E. F. Clark and Messrs Simoni and McFadden of the U.S. Army Cold Regions Research and Engineering Laboratory, Fairbanks, Alaska; Joseph Kastelic, Chief of Bureau of Land Management Division of Fire Control, Anchorage, Alaska; Larry Ouellette of Joint Federal-State Land Use Planning

Commission, Anchorage, Alaska; Robert Currie, Chairman of Arctic Petroleum Operators Association, Calgary, Alberta; and Wayne Tobiasson of U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire.

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LOGISTIC REQUIREMENTS AND CAPABILITIES FOR RESPONSE TO OIL POLLUTION IN ALASKA

to

United States Coast Guard
Washington, DC

from

Battelle
Pacific Northwest Laboratories
Richland, Washington

November, 1974

1.0 INTRODUCTION AND FRAMEWORK

1.1 NATURE OF THE PROBLEM

A recent study[1] of the potential and probable course of development of petroleum production and transportation in Alaska concluded that 1) crude oil reserves in the state are very significant (possibly well in excess of 150 billion recoverable barrels), 2) future petroleum demands will encourage development and extraction of these reserves at a rate of two to three million barrels per day in the near future, 3) geologically favorable areas are widely distributed around the perimeter of Alaska with 70 percent of the reserves expected to be offshore, and 4) the environmental conditions under which response to oil pollution incidents may be undertaken are varied and potentially severe.

As a result of the above findings, it is apparent that logistical considerations will be one of the controlling

factors in the U.S. Coast Guard's capability to meet mission responsibilities for environmental protection under the Federal Water Pollution Control Act. This study therefore is addressed to evaluating the probable logistical support requirements and present capabilities in an effort to identify areas requiring either new development or management actions.

1.2 PRIMARY ELEMENTS INVOLVED IN LOGISTIC CONSIDERATIONS

Logistics is defined as that branch of military science having to do with procurement, movement, maintenance and disposition of supplies, equipment, facilities and personnel and the provision of services. In the context of its application in support of response to oil pollution incidents, the following principal elements are included in the study:

- Operational or Supply Bases
- Staging Bases
- Transportation Systems
  - Aircraft
  - Vessels
  - Land Vehicles
- Quarters and Commissary
- Ancillary Services
  - Communications
  - Forecasting
  - Navigational Aids (aircraft)
  - Resupply

In addition to the above facilities and equipment aspects of logistic support, it is apparent that there are opportunities for administrative actions that offer the potential for markedly augmenting the logistic capability of the Coast Guard. Actions such as interagency agreements should make possible

the establishment of the desired level of capability at a cost less than would be incurred if the Coast Guard were to undertake the full burden of establishing and maintaining standby capability. In view of this condition, such potential administrative actions are considered within the framework of the logistic evaluation.

1.3 CONDITIONS UNIQUE TO ALASKA

By almost any definition the greatest majority of oil production and transportation activities are expected to involve what are now considered as frontier areas. The only exceptions to this generality are the ongoing production in upper Cook Inlet and exploratory and production drilling in the Prudhoe Bay area. The previous study[1] also indicates that the probable resources are geographically widely distributed.

As a consequence, little historical experience exists either in the direct operation of production and transportation facilities or in the logistic aspects attendant to response to oil spills. Necessarily then, evaluation of the logistic requirements and capabilities must be derived from comparison and extrapolation of past operationally-related activities with careful recognition of the conditions unique to the state.

Alaska is large both in area (approximately 586,000 square miles of land mass with an equivalent area offshore to the continental slope) and in dimension (approximately 34,000 miles of coastline). Alaska is almost unpopulated and underdeveloped with the resultant lack of facilities that can be drawn upon in support of oil pollution response. As a consequence, field operations will need to be largely self-sufficient.

Transportation in Alaska has historically developed around aircraft as a result of the rugged terrain and great distances involved. Rail access (Alaska Railroad) is limited, running from Seward and Whittier north to Anchorage and Fairbanks. Road access is presently also limited, particularly in the frontier areas of likely oil production. The Trans-Alaska Pipeline will be paralleled by ground roadway throughout its length. Marine transportation systems are similarly limited and exist mainly in Southeast Alaska.

The production and transportation of significantly increased quantities of oil in Alaska is expected in 1977 or 1978 with the startup of the Trans-Alaska Pipeline at 1.2 million barrels per day, thereafter increasing to 2 to 3 million barrels per day. Lease sales planned in lower Cook Inlet and the Gulf of Alaska would result in production within 8 to 10 years in both areas.

1.4 STUDY FRAMEWORK

The scope of Alaska defies selection of a few typical locations for response analysis that truly encompass the range of physiographic and environmental conditions that could be encountered during future oil spill response. Fourteen key locations were selected from areas identified in a previous study[(1)] as those having relatively high potential for oil spills. The relatively high probability for spills were based on the predictions that the areas would either be sites of crude oil production facilities or located in critical areas of crude oil transportation routes. Offshore spills are assumed at most of the sites because the probable course of future crude oil production will be from offshore fields. Inland spill locations were also selected even though the Coast Guard does not have primary mission responsibility for

response to inland spills under the Federal Water Pollution Control Act. The Coast Guard's presence in Alaska will likely necessitate some form of Coast Guard response to all oil spills in Alaska, regardless of location.

Guideline response requirements for the various types of oil spill locations were provided by the Coast Guard in the original study work statement. The guideline information is tabulated in the introduction to Section 5.0. Environmental scenarios include open water, tundra, moving pack ice, and shorefast ice. The desired response time varies from 10 hours, in the case of open water spills, to 24 hours for onshore locations or oil spills on ice. The equipment to be transported is the same in all cases and personnel requirements vary between 15 and 25 for periods up to 20 days.

The logistic support capability for each of the selected locations was analyzed on the basis of present and projected Coast Guard personnel, equipment, transportation vehicles and facilities in Alaska. Improvements were identified for each area where response capability was felt lacking or questionable. The analysis of response capability was based upon the types of Coast Guard ships and aircraft potentially available rather than the actual number presently in the state or projected for the future. The number of aircraft needed for response can readily be supplemented from military or civilian/federally contracted sources.

In all cases, the logistic support capability evaluation was based upon moving the personnel and equipment from a predesignated supply base to an intermediate staging area and, thence, to the actual spill location. Sources of personnel, equipment, and vehicles from outside the state were not considered in the evaluations.

1.5 RELATIONSHIP TO OTHER COAST GUARD MISSIONS

The primary Coast Guard missions for vessels and aircraft in Alaska are associated with the following programs:

- Search and Rescue
- Enforcement of Laws and Treaties
- Short Range Aids to Navigation
- Marine Environmental Protection
- Domestic Icebreaking
- Marine Science Activities
- Recreational Boating Safety

Aircraft and vessels are additionally used for logistic resupply of remote facilities throughout the state.

Oil spill response activities are included within the Marine Environmental Protection Program. There are no cutters or aircraft dedicated to this purpose so vessels and aircraft must be diverted from other missions. The requirement for rapid response to an unpredictable event closely parallels the needs of search and rescue missions. However, oil spill response activities will generally require a much larger effort sustained over a longer period of time. Oil spill response is also more widespread geographically than other missions, particularly when onshore spills are considered.

The Enforcement of Laws and Treaties and Short Range Aids to Navigation Programs both require widespread deployment of vessels throughout most sub-arctic marine waters. The diversion of vessels located near the spill site for use as working platforms and for field support functions will be invaluable to response efforts.

1.6 RELATIONSHIP TO OTHER FEDERAL GOVERNMENT ACTIVITIES AND MISSIONS

Military and civil activities of the Federal Government are disproportionately large in Alaska as compared to other states, largely due to the fact that the Federal Government has historically controlled or administered approximately 90 percent of the state's land area. Federal Government facilities are widespread throughout the state while Coast Guard facilities are essentially limited to marine areas of the Gulf of Alaska and Southeast Alaska. Elements of the established search and rescue capability of the Army, Air Force and National Guard under the Alaska Command for all areas of the mainland and arctic regions could be used to supplement Coast Guard response capability. Virtually every element required for response logistics is available from the military, except the specific equipment required for oil spill containment and cleanup.

A large and complete rapid response capability has also been established by the Bureau of Land Management for fire-fighting statewide. Elements of the BLM statewide system could supplement Coast Guard response capability, particularly for inland spills during periods of low fire probability.

Federal facilities could serve as supply depots or staging areas for response which, in effect, would extend the presently limited number and location of Coast Guard facilities throughout the state. Federal personnel stationed near specific oil spill sites could provide expert local knowledge regarding most aspects of response logistics to the Coast Guard On-Scene Coordinator.

1.7 RELATED INDUSTRY ACTIVITIES

The oil industry will have contingency plans established for oil production and transfer facilities and transportation systems. The contingency plans can be used as guidelines for Coast Guard response to new areas of crude oil production as they are developed. Contingency plans can never be perfectly developed for exploratory drilling activities and along marine transportation routes. These areas are felt to represent the greatest future demand for complete response by the Coast Guard.

Oil spill cooperatives have been or will be established by the industry in areas of crude oil production and transfer facilities. The resources of the oil spill cooperatives will be available to the Coast Guard for response to either local or distant spills if the oil industry is not capable of responding themselves or not in a position of responsibility for the particular spill.

The fishing industry is of potential value for supplementing Coast Guard oil spill response capability. Fishing vessels are widely dispersed throughout the sub-arctic marine waters seasonally and have the knowledge required to navigate virtually all waters of the state. Many types of fishing vessels are uniquely adaptable to oil spill response operations in local waters due to either their configuration or the types fishing gear and auxiliary vessels carried. The thousands of vessels which comprise the Alaskan fishing fleet are statistically more likely to be at or near any marine spill than all other potential sources of transportation combined.

1.0 REFERENCES CITED

1. W.H. Swift, et al., "Geographical Analysis of Oil Spill Potential Associated with Alaskan Oil Production and Transportation Systems", Dept. of Transportation, U.S. Coast Guard Report No. CG-D-79-74, February 1974.

2.0 SUMMARY AND CONCLUSIONS

The basic logistic elements required for oil spill response throughout Alaska have been divided into three categories for purposes of evaluating capability:

- Primary transportation
- Secondary transportation
- Field support functions

The discussion below is divided into the requirements and capabilities for arctic response in general as compared to sub-arctic response. The seasonal overlap of arctic and sub-arctic requirements precludes precise delineation of either region. However, a significant difference was found between the two generic regions in that the availability of Coast Guard cutters is highly unlikely in arctic regions while a reasonable possibility exists that cutters would be available for some aspect of sub-arctic response. The unavailability of cutters for operations in the Arctic is due to both distance from locations considered likely as supply bases and also removal from areas that Coast Guard vessels normally operate on other missions.

2.1 LOGISTIC REQUIREMENTS IN ARCTIC AREAS

The assumed unavailability of cutters in the Arctic complicates response operations because cutters can provide secondary transportation, a working platform, and most field support functions such as personnel support and long range communications at least temporarily at the spill location. Primary transportation entails the movement of personnel and equipment from a pre-selected supply base to a suitable staging area near the spill location. The relatively great distances between potential supply bases and the spill locations virtually precludes the use of anything but heavy transport aircraft such as the

HC-130 for movement of equipment and personnel, although personnel could be transported by smaller aircraft or helicopters to some areas.

The minimum requirements for year-round airfield suitability for HC-130 operations are a runway in excess of 4,000 feet, landing lights, instrument landing equipment and snow removal equipment. Hangars and a source of JP fuel are highly desireable. Lack of suitable airports near the spill location in some Arctic areas will necessitate a second mode of primary transportation to complete the primary transportation cycle from the airport to a staging area. Vehicles used to complete this ground leg of the primary transportation cycle will normally have to be transported to the airport by additional heavy transport aircraft due to a general lack of any type of transportation vehicles in the Arctic. Helicopters ferried to the site could be used to complete the ground leg of the primary transportation cycle if the distance to the spill location was not over about 50 miles and the weight of individual pieces of equipment did not exceed a few thousand pounds. The only means identified to avoid the requirement for a suitable airfield would be development of complete air-drop capability for all heavy equipment.

The extreme cold temperatures in the winter (-50°F or colder) will incapacitate personnel or equipment not specifically prepared or designed to operate at those temperatures. Coast Guard aircraft normally do not operate for extended periods in extreme cold; thus, special preparations may be required for Arctic winter operations. Personnel should be well-versed in Arctic survival, rather than merely trained.

Secondary transportation vehicles must have multi-terrain capability in the Arctic for either summer or winter operations. The single most important requirement of secondary transportation

vehicles is that of air-transportability by HC-130 or smaller aircraft. The only exception identified to this requirement is use of helicopters that can be rapidly ferried to the site.

Preselection of routes is not possible during rapid response operations so secondary vehicles must have the capability to traverse all types of terrain and environmental conditions encountered seasonally in the Arctic. Onshore travel over the tundra during the summer can generally be accomplished with almost any type of tracked or balloon-tired vehicles, although they are slow and tracked vehicles may cause environmental damage. Amphibious capability is almost mandatory in many areas due to numerous streams, lakes, or rivers. Winter travel in the same areas is relatively easier and does not require amphibious capability. However, the traversing of areas where deep soft winter snow exists is very difficult, being limited to vehicles with high ground clearance. Offshore operations during the winter in Arctic areas is hazardous, especially on moving pack ice. Darkness and the potential instability of the ice will require the most reliable of vehicles operating on the buddy system (two or more vehicles on each mission). Secondary transportation vehicles will further require multi-terrain capability to cross pressure-ridges, open water or leads in the ice, hummocks and snow. Every person familiar with arctic operations interviewed during the course of the study felt that staging areas should <u>not</u> be set up on the ice.

An important feature of secondary transportation vehicles is the provision of a working platform at the spill site. Helicopters are presently the most versatile means of secondary transportation over arctic ice, but they do not provide a working platform. Surface Effect Vehicles show promise for the necessary multi-terrain capability and provision of a working platform, but are not likely to be readily air-transportable. A satisfactory type of secondary transportation vehicle for operations

on the ice in the Arctic for rapid spill response could not be clearly identified during this study. Helicopters were clearly the closest to being satisfactory at the present state of arctic transportation technology.

Field support for arctic operations during the summer or winter will generally require complete self-sufficiency due to an area-wide lack of established facilities capable of supporting field operations. Long-range and short-range communications, fuel, medical services, and all personnel support functions to sustain the cleanup operations such as food and shelter will have to be transported to the site from either the supply base or a closer center of transportation. Adequate outdoor lighting may be additionally required during the winter darkness.

2.2 PRESENT COAST GUARD ARCTIC LOGISTIC SUPPORT CAPABILITY

The conclusions from the evaluations in Section 5.0 regarding requirements as compared to present capability for arctic logistic support is that the Coast Guard cannot respond to open water spills within the desired 10 hours or to spills on moving pack ice, shorefast ice, or the tundra throughout most areas of the Arctic within 24 hours using only Coast Guard equipment. Primary constraints to response are a lack of suitable secondary transportation vehicles, lack of field support equipment to sustain onshore operations for extended periods, and the relatively great distances between potential Coast Guard support facilities and the Arctic.

The most likely choice of present Coast Guard facilities for a supply base for arctic operations is the Base and Air Station at Kodiak because Kodiak is the nearest source of personnel and transportation vehicles. Kodiak is not an all-weather airport and is further felt too far removed from the Arctic to provide rapid and effective primary transportation response.

HH-3F helicopters are the only source of universal secondary transportation for arctic operations in the Coast Guard inventory. The Air Force recently estimated that an HH-3 would require 10.5 hours enroute from Elmendorf Air Force Base in Anchorage to Barrow including one in-flight refueling.[1] Similar aircraft from Kodiak would require up to several hours longer enroute due to the greater distance and necessity to refuel on the ground.

The HC-130 aircraft is probably the best large arctic logistic support aircraft available in the world. However, special adaptations such as ski equipment for landing on snow, airdrop capability for all heavy equipment, and adaptations for cold weather operation are required to fully utilize these aircraft. The number of HC-130's and HH-3F's available for oil spill response operations throughout Alaska at any given time is probably inadequate. Up to three of each type may be required for response to remote Arctic areas.

2.3 ARCTIC LOGISTIC SUPPORT CAPABILITY OF OTHER GOVERNMENT AGENCIES AND PRIVATE INDUSTRY

Army and Air Force Bases located near Anchorage and Fairbanks can provide virtually any type of transportation or field support required for arctic response. The Alaska Command has an established search and rescue capability throughout the Arctic. The Air Force maintains DEW Line Stations along the Arctic coastline which could provide limited support and serve as staging areas for response operations. Large helicopters and off-road vehicles maintained by the Army at Fort Wainwright are potentially available for deployment to oil spills in the Arctic. Field camp equipment and facilities available from the Army at Fort Wainwright, Fort Greeley or Fort Richardson could provide the necessary field support functions. The Naval Arctic Research Laboratory at Barrow has been used as a

logistic support base for arctic ice operations for many years and could be used similarly by the Coast Guard.

Private industry is concentrated at a very few arctic locations such as Prudhoe Bay and their potential contribution in the area of arctic logistic support is felt to be of limited value as compared to that of the military. However, future expansion of the petroleum industry throughout the Arctic may improve the potential for support.

2.4 LOGISTIC REQUIREMENTS IN SUB-ARCTIC AREAS

Primary transportation requirements for sub-arctic areas can potentially be provided by vessels, aircraft or land vehicles, either individually or in combination. Vessels must have full sea keeping capability for year-round operation in the Gulf of Alaska or areas of the Bering Sea. The 180-ft Seagoing Buoy Tenders, Medium Endurance Cutters and High Endurance Cutters operating in Alaska are all well-suited for logistic support operations. The use of cutters for primary transportation is feasible only in the case of spills near the supply base (within approximately 200 nautical miles) due to lack of speed. Land vehicles would be used only for onshore locations if the supply base was located in Anchorage or Fairbanks.

Large transport aircraft such as the HC-130 are the only piece of Coast Guard equipment capable of delivering the desired amount of equipment to most sub-arctic sites within 10 hours for open water spills. Airfield requirements are the same as those for arctic operations, but more suitable airfields exist throughout the sub-arctic regions. HH-3F helicopters can be used to transport personnel to most sub-arctic locations within the desired response time. City docks or terminal facilities will make suitable staging areas for most marine spills. Airdrop capability for the heavy equipment

would greatly improve primary transportation response by eliminating the need for an intermediate transfer of equipment at a major airfield.

Secondary transportation in sub-arctic regions can be provided by vessels, helicopters or off-road vehicles. Land vehicles are locally available at some locations, but must be air-transported to the nearest airport in the general case, which will necessitate additional heavy transport aircraft. Tracked or balloon-tired vehicles will traverse most sub-arctic terrains during summer or winter. Amphibious capability is desirable for summer operations.

Vessels such as cutters are the best means of secondary transportation available for marine spills because they provide a large and stable working platform at the spill site. The auxiliary equipment carried such as launches, pumps and hoses can significantly aid in cleanup operations.

Field support functions are more likely to be available in the immediate spill area in sub-arctic regions as compared to arctic areas. However, there are still locations that will require that virtually all field support be brought to the site. Cutters are invaluable in this respect as they can provide virtually all field support at least temporarily. JP fuel for aircraft operations will have to be brought from external sources in most instances.

2.5 PRESENT COAST GUARD SUB-ARCTIC LOGISTIC SUPPORT CAPABILITY

The conclusion from evaluations in Section 5.0 regarding requirements as compared to present capability in sub-arctic regions is that the Coast Guard cannot respond to the majority of open water spills within 10 hours or spills on sea ice within 24 hours using only Coast Guard equipment. The primary

constraints are a lack of secondary transportation vehicles, working platforms, and personnel support equipment for extended field operations.

Response within the desired time period will be possible if one of the two following conditions exists: 1) the spill is within 100-150 nautical miles of the supply base or (2) a cutter is available within 100-150 nautical miles of the spill location. Areas of open water spills considered within present Coast Guard response capability are the mouth of Cook Inlet and Prince William Sound. Response to all areas of Cook Inlet during the winter is possible within 24 hours if an icebreaker is available at Kodiak or within Cook Inlet.

Location of the supply base at Kodiak is satisfactory for sub-arctic response using primarily Coast Guard transportation vehicles. Anchorage would be a more satisfactory location if use is made of the resources of outside agencies.

2.6 SUB-ARCTIC LOGISTIC SUPPORT CAPABILITY OF OTHER GOVERNMENT AGENCIES AND PRIVATE INDUSTRY

The Army and Air Force Bases near Anchorage are a potential source of virtually every logistic support element needed for oil spill response operations, except the equipment for cleaning up spills. Vehicles for primary or secondary transportation are readily available as well as portable field camps for sustaining personnel. Military stations could additionally provide limited field support and serve as staging areas at some sub-arctic locations.

The Bureau of Land Management has a well-established organization for firefighting on the mainland. Direct use of the organization may be feasible for onshore spills. The field support equipment might further be available to the Coast Guard during periods of low fire probability (October-May).

The oil industry has or will establish oil spill cooperatives in areas of major oil production and transfer such as Cook Inlet, Prince William Sound and offshore in the central Gulf of Alaska. The resources of the cooperatives will be available to the Coast Guard.

Local fishing vessels may provide a very significant additional secondary transportation response capability where Coast Guard vessels are not immediately available. The fishing vessels, in many cases, are uniquely adaptable to oil spill cleanup operations in local waters.

2.0 REFERENCES CITED

1. Department of the Air Force, Headquarters Alaskan Air Command, "Alaska Command Exercise Plan - Polar Cap 74," November 30, 1974.

3.0 RECOMMENDATIONS

The probable course of future crude oil production and transportation system development will remain somewhat concentrated geographically for the next 8-10 years. Production and transportation will be limited essentially to crude oil from the Cook Inlet and Prudhoe Bay fields. Petroleum developments beyond that period will rapidly spread throughout virtually all offshore areas surrounding the mainland and to new onshore areas in both the Arctic and sub-Arctic. Recommendations to supplement the logistic support capability of the Coast Guard for oil spill response are accordingly divided into short range (covering the coming 8-10 years) and long range for the period beyond. It should be recognized that many of the developments recommended for long range application must begin within the near future to become effective in time.

3.1 SHORT RANGE RECOMMENDATIONS

1) Logistic support capability can be greatly supplemented by administrative actions in the form of cooperative or mutual aid agreements with outside agencies and private industry. The military is the best source of support for statewide response. The establishment of major oil spills as a national disaster would facilitate military cooperation. Local support potentially available varies with specific location but can be more valuable in certain instances. Therefore, it is recommended that the Coast Guard initiate contacts with the Alaska Command, Bureau of Land Management Fire Control Division, other appropriate state and federal agencies, the petroleum industry, the fishing industry, and other private sources with the objective of establishing firm cooperative commitments for logistic support. A

survey of existing cooperative agreements between other state and federal agencies and private industry would be a good starting point.

2) The Strike Teams of the National Strike Force are a source of trained personnel for oil spill field operations which simplifies response logistics. The Pacific Strike Team based in San Francisco is felt too distant geographically for response to Alaskan spills. Therefore, it is recommended that a National Strike Team be established in either Anchorage or Kodiak to provide the majority of required field personnel and to supervise equipment transportation and handling.

3) The relatively great distances between supply bases and potential spill locations, lack of suitable airfields or staging areas near the spill sites, local unavailability of secondary transportation vehicles, and inaccessibility to the sites by overland routes will add costly delays in transporting equipment from a suitable airfield to the spill location. Airdrop capability for heavier equipment would bypass most of these constraints because it is easier to transport personnel locally than heavy equipment. Therefore, it is recommended that the Coast Guard develop airdrop capability for all critical items of heavy equipment. A crucial element of preparedness is that all equipment be properly containerized for rapid handling and loading into any available mode of conveyance. It is further recommended that all available equipment that might be required for oil spill field operations be completely prepackaged in a form suitable for handling and transport by all aircraft, vessels and land vehicles potentially available for transport. A field exercise entailing deployment of oil

spill cleanup and containment equipment available within Alaska is also suggested.

4) HH-3F helicopters are the only present method of secondary transportation in many remote, distant, or, otherwise, inaccessible areas. Enroute refueling will be required for access to areas farther than 500-700 nautical miles from the point of origin. The JP fuel required by helicopters is not available throughout most areas of Alaska; thus, fuel will have to be brought to the site by an additional aircraft to sustain field operations. It is recommended that the Coast Guard establish helicopter refueling stations at points that will minimize the distance traveled during helicopter ferry operations to any point on the mainland of Alaska. Refueling points could be established either at existing airfields or by caching bladder bags of fuel at appropriate locations.

3.2 LONG RANGE RECOMMENDATIONS

1) Surface Effect Vehicles (SEV's) have great potential for emergency response operations throughout Alaska. However, the present state of development makes arctic operations potentially hazardous due to lack of maneuverability and undesirable handling characteristics. Developments are underway to incorporate the advantages of SEV's into modified land vehicles. It is felt that a better approach would be to incorporate the inherent control and stability of land vehicles into modified SEV's. Therefore, it is recommended that the Coast Guard undertake a program to develop a modified SEV with an optional ground contact system to provide control and stability over rough terrains. The SEV should be of sufficient size to provide primary transportation of all personnel and equipment and have an operating range up to 1,000 miles. It is further recommended

that the initial phases of future SEV field tests be conducted in Bristol Bay. Environmental conditions in the winter are similar to those in the Arctic (sea ice, snow, etc.) without the climatic extremes. Summer environmental conditions are similar to those found in the remaining coastal areas. Such factors as the intense fishing activity by foreign and domestic fleets, the need to install seasonal navigation aids, the very shallow coastal waters, and lack of ports and harbors would permit evaluation of the adaptability of SEV's to virtually all Coast Guard missions in Alaska.

2) A present lack of air-transportable secondary transportation vehicles will limit area shoreline access or all onshore area travel to helicopters at most potential spill locations. Travel by land vehicle is safer and more reliable during hostile climatic conditions. Therefore, it is recommended that a systems study be performed of potential air-transportable All Terrain Vehicles that will fulfill specific logistic support requirements several years hence. The study will have to consider field support and oil spill cleanup and containment equipment specifically developed or adapted for Alaskan oil spill response. More than one type of vehicle may be required, depending on the spill location.

3) The Coast Guard presently lacks portable shelters and other field support functions for deployment of personnel onshore. Related military developments may not be entirely suitable for Alaskan oil spill response. It is recommended that a a systems study be made regarding the number of personnel, levels of habitability, modes of transportation available and auxiliary equipment required such as heaters and a water supply prior to the time such a system will be required. Rapid developments in materials technology are making present forms of portable shelters obsolete. The

systems study should include a survey of the latest military and industrial portable shelter developments immediately prior to procurement.

4) Establishment of a supply base (or bases) and Strike Team personnel at the proper location will become increasingly important as petroleum developments become more widespread throughout Alaska. Logistic response requirements may be significantly different for arctic spills as compared to sub-arctic spills. Past operational experience from established search and rescue bases would be an excellent indicator of suitability for operational bases for oil spill logistic support. <u>It is recommended that a survey of past search and rescue operational experience from Kodiak be made and compared to similar operational experience from military bases at Anchorage and Fairbanks</u>. Reliance on military assistance may not be advantageous to long range Coast Guard rapid response missions to the Arctic. The establishment of new facilities or expansion of existing facilities on the mainland may be required.

5) The reliance on aircraft for virtually all primary transportation response throughout Alaska suggests that improvements in aircraft performance would be one of the best means to improve overall logistic response capability. The HC-130 and HH-3F are both basically well-suited to logistic support in Alaska. However, modifications could extend the capability or improve the performance of both aircraft. <u>Therefore, it is recommended that the Coast Guard undertake a cost-effectiveness study of the following aircraft improvements: in-flight refueling of HH-3F helicopters by modified HC-130 aircraft, adaptation of HH-3F helicopters to year-round and all-weather operations from High Endurance Cutters, adaptation of the HH-3F and</u>

HC-130 aircraft for extended operations at extreme cold temperatures (below -50°F), procurement of tricycle ski landing gear for the HC-130 aircraft, procurement or development of an air cushion landing system for HC-130 aircraft. The Air Force routinely refuels HH-3 helicopters in-flight from C-130N aircraft. Arctic response would be enhanced if the Coast Guard had a similar capability. Other long range missions such as fishery surveillance operations over open water could similarly be enhanced.

4.0 DISCUSSION

4.1 CURRENT AND PROJECTED COAST GUARD LOGISTIC SUPPORT CAPABILITY

The logistic support capability of the Coast Guard for rapid response to oil spills within Alaska will depend almost entirely upon the availability of logistic elements located within the state when the spill occurs. The following guidelines for response time were specified in the original work statement for the present study:

Environmental Description	Response Time
Moving pack ice	24 hours
Open water	10 hours
Shorefast ice	24 hours
Tundra	24 hours

Other Coast Guard Districts and functions such as the Pacific Strike Team of the National Strike Force (based in San Francisco) are felt too far removed geographically to consistently provide equipment or transportation support within the desired response time of less than 24 hours statewide.

Support in the form of personnel or light equipment could come from outside the state within 24 hours under nearly ideal circumstances. The desired response time of 10 hours for open water spills virtually precludes any form of logistic support from the "Lower 48" states. The distance between Seattle and Anchorage is approximately 1,450 statute miles and San Francisco is more than 2,000 statute miles from Anchorage. The flying time of the fastest commercial jets between Seattle and Anchorage is approximately 3 1/2 hours. However, scheduled flights between the Northwest and Anchorage depart only between the hours of 7:00 a.m. and 9:30 p.m. The overnight lull in

departures of nearly 10 hours, the time required to call up personnel and transport them to the airport, and the invariable delays in communications would place Coast Guard personnel from outside the Alaska District up to 20 hours or more from Anchorage following a request for assistance. Coast Guard HC-130 aircraft from the Northwest or San Francisco could fly to Anchorage nonstop in 5-8 hours. However, the response time considering all other factors such as calling up personnel, fueling the aircraft, etc., would place earliest arrival in Anchorage at 10-12 hours following notification.

The Pacific Strike Team in San Francisco has trained personnel and specialized equipment to contain and clean up oil spills and unload stricken tankers (ADAPTS System). The trained personnel and the majority of the equipment for oil spill cleanup do not presently exist in Alaska. The limited amount of the Coast Guard oil containment and/or cleanup equipment within Alaska is stored at Elmendorf Air Force Base in Anchorage.(1) The Pacific Strike Team personnel and equipment could provide the backbone of logistic support if adequate transportation were available or they were located closer to or within Alaska. Strike Team personnel estimated that at least 24 hours would normally be required for transportation of the heavier equipment to Anchorage.(2) The Pacific Strike Team and ADAPTS system were requested at the site of an oil spill at Cold Bay, Alaska, during March of 1973 by the On-Scene Commander. The Strike Team personnel arrived 14-18 hours later; the ADAPTS pumping system arrived on-scene approximately two days later.(3)

The present Coast Guard logistic support capability related to primary transportation in response to marine oil spills in sub-arctic regions is probably the best established

system within the state. The transportation support capability for oil spills in Arctic regions and inland spills on the mainland is felt to be inadequate. Response capability within the State varies considerably by area and on a seasonal basis. The seasonal aspect of support capability is particularly true in Arctic regions. Coast Guard facilities located within Alaska are described in Section 4.4.2.

The availability of vessels (assumed to be cutters) and aircraft for either primary transportation or field support will normally require diverting of the aircraft or vessels from other assigned missions. The missions of Coast Guard vessels and aircraft operating in Alaska are primarily associated with the following programs:[4]

- Search and Rescue
- Enforcement of Laws and Treaties
- Short Range Aids to Navigation
- Marine Environmental Protection
- Domestic Icebreaking
- Marine Science Activities
- Recreational Boating Safety

It is assumed for purposes of this study that immediate diversion of vessels and aircraft from other assigned missions will be made in the event of a major oil spill, except for search and rescue operations and, possibly, hot pursuit of fishing treaty violators.

One transportation response system that is unique to the Coast Guard within Alaska is the combined use of ships and helicopters for either primary transportation or field support. The capability to operate and refuel HH-3F helicopters from High Endurance Cutters (WHEC's) and the smaller HH-52A helicopters from both Medium and High Endurance Cutters could be

invaluable for oil spill response logistics. The combined ship/helicopter capability is currently not operational in Alaska during the winter.[5] Neither High Endurance Cutters nor HH-52A helicopters are presently permanently stationed in Alaska. Thus, the capability for combined ship/helicopter operation is dependent primarily upon both ships and aircraft temporarily assigned to Alaska from other Districts.

The logistic response times tabulated earlier (10 hours for open sea spills and 24 hours for other types) lead to the obvious conclusion that aircraft are going to be required for the primary transportation of men and equipment to most of the potential spill locations statewide. Vessels assigned to other missions simply cannot return to a supply base, load equipment and personnel, and steam to the spill site within 10 hours in the case of open sea spills and 24 hours for other spills. The need for aircraft as the major primary transportation vehicles would change only if all ships on patrol were equipped with the necessary oil spill cleanup and support equipment. For oil spill locations relatively close to a supply depot (less than 200 nautical miles), a ship on standby at the supply base might respond within the desired time. The HC-130 aircraft are the sole means under Coast Guard control for rapid oil spill response in Arctic regions at present.

4.1.1 Vessels

Vessels available for primary transportation response within Alaska would come from a combination of Coast Guard vessels either stationed in Alaska or temporarily assigned to missions within the 17th Coast Guard District. The vessels available would be predominantly limited to cutters and include the following types:

- High Endurance Cutters (WHEC's)
- Medium Endurance Cutters (WMEC's)
- Icebreakers (WAGB's)

  WIND Class
  GLACIER
  POLAR Class (operational by 1976 or 1977)
- Large Patrol Craft (WPB's)
- Seagoing Buoy Tenders (WLB's)
- Inland Buoy Tenders (WLI's)

Specifications for these vessels appear in Appendix A.

Cutters stationed in Alaska as of 1973 are shown in Table 4-1 below:[6]

TABLE 4-1

SUMMARY OF CUTTERS STATIONED IN ALASKA

Type/Name	Permanent Station		Remarks
WMEC			
CONFIDENCE	Kodiak	210	A Class
STORIS	Kodiak	230	Class, ice-reinforced
WLB			
BALSAM	Adak	180	A Class, ice-reinforced
BITTERSWEET	Ketchikan	180	C Class
CITRUS	Kodiak	180	A Class, ice-reinforced
CLOVER	Sitka	180	A Class
IRONWOOD or SEDGE	Homer	180	B Class
SORREL	Cordova	180	A Class, ice-reinforced
SWEETBRIAR	Juneau	180	C Class
WPB			
CAPE CORAL	Juneau	95	A Class
CAPE ROMAIN	Ketchikan	95	B Class
CAPE HENLOPEN	Petersburg	95	C Class
CAPE JELLISON	Seward	95	B Class
WLI			
ELDERBERRY	Petersburg	65400	Class

The anticipated number of cutters required by the Coast Guard 17th District up to 1985 is shown below in Table 4-2:[4]

TABLE 4-2

NUMBER OF CUTTERS REQUIRED BY 17th CG DISTRICT TO 1985

Type	1975	1980	1985	Stationed in Alaska 1973
WHEC*	7	7	7	0
WMEC	4	4	4	2
WLB	8	7	7	7
WPB	7	8	9	4
WLI	1	1	1	1
DI-I**	1	1	1	0

* Required by West Coast Area B rather than 17th CG District
** DI-I is Type I icebreaker (designed to break 3.5 feet of blue ice)

The cutter requirements in Alaska during the next 10 years will presumably be made up of a combination of vessels permanently stationed in Alaska and vessels assigned from other areas. The most significant change noted in the future requirements as compared to the present availability of vessels is the need for seven High Endurance Cutters during each quarter of the year. The Operations/Logistics Employment Schedule of the 17th CG District for the 1st and 2nd Quarters of FY-75 shows 7 WHEC's during the 1st Quarter and only four during the second Quarter.[7] Only one WHEC is scheduled in Alaska during December of 1974. Presumably, the number available during any month in the future will increase.

The primary mission planned for the High Endurance Cutters in Alaska over the next 10 years is fishery patrols. The patrols place the vessels in marine waters throughout the

sub-arctic areas and Bering Sea. Thus, a High Endurance Cutter is likely to be near the scene of a marine oil spill. Fishery patrols are more frequent in the summer due to increased fishing activity so the probability that a WHEC will be in the general area of a spill is higher in the summer. These vessels would provide good bases for field support and also serve very well as communications or coordination centers at the site. There is little or no chance for use as primary transportation vessels if the vessels are on patrol at the time of the spill unless the men and equipment could be airlifted to a nearby port and transferred to the cutter.

The Medium Endurance Cutters are primarily scheduled for search and rescue, fishery patrols and marine research activities in sub-arctic waters. The WHEC's would similarly serve well as bases for field support and coordination centers. Use of WHEC's as primary transportation vessels would be limited to spills near the supply base or transporting men and equipment airlifted to a port near the spill site.

The Offshore Buoy Tenders (WLB's) are primarily scheduled for servicing of aids to navigation. Most of the sailings are during the summer season in waters around the mainland because of winter ice. The WLB's could serve in the same capacity as the WHEC's and WMEC's at the spill site. The Large Patrol Boats (WPB's) are scheduled primarily for search and rescue. Use as field support bases or coordination centers would be limited due to the smaller size and lack of auxiliary equipment.

4.1.2 Aircraft

Two types of Coast Guard aircraft are presently stationed in Alaska: the HC-130 and the HH-3F amphibious helicopter.

Specifications for these aircraft appear in Appendix A. Approximately four of each type of aircraft are stationed at the Coast Guard Base in Kodiak. Another Coast Guard Air Station is presently located on Annette Island near Ketchikan. The Annette air facility is currently being moved to Sitka and is scheduled to be operational there by mid-1976.(8) Three HH-3F helicopters and two HC-130's will operate from Sitka at that time.

The HC-130 aircraft are presently used primarily for search and rescue, fishery patrols, inspection and logistic support of Coast Guard facilities throughout the state. The HC-130 is the only means of conveyance owned by the Coast Guard that can consistently provide rapid primary transportation for men and equipment to most potential oil spill locations throughout Alaska. The Coast Guard HC-130's are not ski-equipped, so the capability to operate in the Arctic during the winter will be primarily limited to the larger airfields that are maintained year-round.

The HH-3F helicopter is routinely used for search and rescue. The normal range of 300-400 nautical miles can be extended by refueling on the ground directly from the HC-130 aircraft. Both aircraft use the same fuel. HH-3F's have been flown from Kodiak to Dutch Harbor and refueled by an advance HC-130 to permit search and rescue operations in the Bering Sea.(9) The HC-130's in Kodiak also have an established capability to air drop fuel in bladder bags for refueling the helicopters. The primary value of the HH-3F aircraft for oil spill response logistics would be in the area of field support and local transportation.

The HH-3F's can be operated from 12 High Endurance Cutters designed to accommodate them.(10) As of 1973, 6 icebreakers and 18 Medium Endurance Cutters had flight decks to accommodate

the smaller HH-52A helicopters. The ship/helicopter combination can provide or extend several present Coast Guard logistic support capabilities for oil spill response:

- Provide a base or airfield for helicopter operations in areas devoid of shoreside access.
- Extend the effective range of ship operations for marine spills in shallow waters.
- Provide access to any onshore spills within the operating range of the helicopter.
- Provide medical evacuation and other field services in a safe and efficient manner.

Ship/helicopters operations are not presently conducted in Alaska during heavy seas or in the winter, as mentioned earlier. A study by Battelle-Columbus for the Coast Guard in 1973[10] identified the following limits to more effective use:

Present Limits

- Limited navigational capability on the HH-52A
- Night-lighting problems on the WHEC's and WMEC's
- Lack of an adequate night-horizon reference for the approaching aircraft
- Inadequate flight deck protection
- Too many persons on deck during helicopter operations
- Some pilots' aversion to sea duty
- Lack of available equipment, particularly helicopters and possibly HH-3F inflight refueling gear
- Operational ship pitch and roll limits are not presently limiting ship/helo operations

Possible Future Limits

- Helicopter shipboard maintenance could be a limit for deployment on ships for periods over one month.
- Lack of a rapid-securing system. Would be limiting for operations on rough seas.

4.1.3 Land Vehicles

The Coast Guard does not have adequate land vehicles for primary or field support transportation functions in response to either Arctic or sub-Arctic oil spills. The only vehicles available are those at Coast Guard facilities state-wide. Existing vehicles are limited to standard passenger vehicles and commercial pickups, flatbed trucks and four-wheel drive pickups, Carryall type trucks and similar commercial vehicles. No capability for off-road travel in snow or across the tundra was identified during field interviews.

4.1 REFERENCES CITED

1. Personal Communication with Marine Inspection Office in Anchorage.

2. Personal Communication with Lt. O'Brien of Pacific Strike Team.

3. H. C. Lyons, "On-Scene Coordinator's Report - Major Oil Spill, Cold Bay, Alaska on 7 March 1973."

4. U.S. Dept. of Transportation, U.S. Coast Guard, 1973 Cutter Plan Report, 13 February 1974.

5. Personal Communication with Comdr. R. T. Martin, Operations Officer at Kodiak Air Station.

6. U.S. Dept. of Transportation, U.S. Coast Guard, Register of Cutters of the U.S. Coast Guard, CG-197, 1 January 1973.

7. U.S. Dept. of Transportation, U.S. Coast Guard, "Operations/ Logistic Employment Schedule for 1st Quarter FY-75 and the Proposed Schedule for 2nd Quarter FY-75," CGD Seventeen Notice 3120, 5 June 1974.

8. Alaska, XL(10):62, October 1974.

9. Personal Communication with Comdr. R. T. Martin, Operations Officer at Kodiak Air Station.

10. R. A. Egen, et al., "Ship-Helicopter Analysis," Report to Coast Guard Under Task VIII of Contract NO. DOT-CG-23223A, 7 December 1973.

4.2 LOGISTIC SUPPORT CAPABILITY OF OTHER GOVERNMENT AGENCIES AND PRIVATE INDUSTRY

Logistic support for oil spill response could potentially be available to the Coast Guard from numerous Federal, State and private industry sources. Support functions would include:

- Primary and local transportation
- Personnel (including advisors)
- Supplies
- Facilities for supply depots or staging areas
- Hotel, commissary and medical services
- Communications
- Support services (weather forecasting, vehicle maintenance, etc.)

Major oil spills in Alaska will undoubtedly elicit a willingness to cooperate or provide assistance from almost all governmental agencies and many sectors of private industry. The willingness to cooperate is perhaps best exemplified by the numerous private citizens and organizations that volunteer services for fighting or cleaning up well-publicized spills in the "Lower 48" states.

The Coast Guard cannot effectively make use of outside assistance for rapid response to oil spills without careful pre-planning and the prior establishment of interagency agreements. Local logistic support at the scene of the spill will always entail an element of opportunity (i.e. personnel, ships, aircraft or vehicles that are near the scene when the oil spill event occurs). However, many potential logistic support functions are available from centers of transportation such as the Anchorage and Fairbanks areas. Many of the same support functions are also available, to a lesser degree, from the larger cities, towns or villages throughout the state.

The Coast Guard On-Scene Coordinator should not have to make time-consuming decisions regarding alternative means of transportation or logistic support. A certain amount of judgement based on prevailing conditions is to be expected. However, an up-to-date compilation of the logistic support functions or elements available from outside agencies by region within Alaska would significantly improve the overall oil spill response effort in many, if not most, potential oil spills. The compilation of support functions would include both what is available on a seasonal basis and how to obtain the support in the shortest possible time.

Primary logistic support functions such as transportation of men and equipment between a supply depot and an on-scene staging area is felt to be the most valuable potential contribution from outside agencies to Coast Guard oil response efforts. The support functions would increase in value for oil spill response efforts in the Arctic regions that are a considerable distance from Coast Guard facilities. This type of support would be essentially limited to established emergency response organizations such as military Search and Rescue (SAR) Units, the National Guard, or the Bureau of Land Management Division of Fire Control which can respond to situations state-wide. The use of established transportation systems or charter aircraft might be effective in some spill situations if prior agreement on procedure had been established. Sources that might potentially provide primary transportation for oil spill response throughout the mainland of Alaska are identified in the succeeding subsections.

Primary transportation of personnel, equipment and supplies to the oil spill site by existing commercial carriers or transportation systems will probably not be effective in most areas of

Alaska. Commercial airlines are likely to be used for transport between the "Lower 48" states and points in Alaska in the event that equipment or personnel is brought in from outside. A scant number of marine and land transportation systems exist within the State. Most that do exist are located either in Southeast Alaska or the South-Central portion of the mainland between Anchorage, Fairbanks and the Canadian border. Only one railroad exists on the mainland of Alaska (between Whittier and Fairbanks). Charter services for local transport are common throughout the sub-Arctic regions of Alaska, but many operate only seasonally. Commercial charter aircraft have been used extensively for airlifts to the North Slope. The local availability of charter transportation services can fluctuate greatly from year to year, depending on construction activities.

Air transportation is an almost universal method for moving men and materials to and from remote areas of Alaska. Commercial airline routes encompass virtually the entire State and normally operate on a year-round basis. Alaska had a total of 667 public and private airports in 1970 which is comparable to the 699 existing in California.(1) The air transportation systems are of particular value in the Arctic regions where land transportation systems operate primarily in the winter and marine transport is restricted almost exclusively to summer travel. The relatively great distances between outlying points of the state favor air transport for primary logistic response to oil spills in almost all areas onshore and in the Arctic.

Support to the Coast Guard for oil spill response logistics in the form of personnel is potentially available from several governmental agencies and private industry sources. The personnel might serve in the following capacities:

- Expert advisors on local conditions and related access problems
- Field services such as medical aid or weather prediction
- Forecasting of environmental conditions
- Oil spill cleanup crews

Federal and state agencies have personnel stationed statewide who are very knowledgeable about the local conditions. Some of these personnel may also have means of local transportation or other logistic support at their disposal. Personnel from many of the Alaskan villages on the mainland have been trained to fight forest fires within Alaska (See Section 4.2.2). The villagers will be much closer geographically to the scene of the spill than available Coast Guard personnel in virtually all potential spill locations on the mainland or in the Arctic regions. The villagers are inherently adapted to living and working under Arctic conditions. Army personnel trained in Arctic survival are also potentially available from Fort Richardson, Fort Greely, or Fort Wainwright.

Logistic support in the form of support equipment, supplies, facilities or field services are potentially available to the Coast Guard on a statewide basis from various military, governmental and industrial sources. Federal agencies maintain wildlife refuges, national parks, national monuments, national forests and a petroleum reserve along all coastlines of the state and in sections of the interior. The Army and Air Force have bases near Anchorage and Fairbanks and maintain stations or facilities elsewhere throughout Alaska and along the Arctic Coast (DEW Line Sites).

The following sections are a summary of the most promising sources of logistic support to the Coast Guard for oil spill

response within Alaska. The sources identified are considered to have potential value for oil spill response support because one or more of the following conditions exist:

- A proven capability for response to emergency situations
- Equipment, personnel, services, local transportation, or facilities that might be made available to the Coast Guard that is located near the areas of high oil spill potential
- Equipment, personnel, services or transportation vehicles available that are located near centers of transportation

4.2.1 Department of Defense

United States Air Force

The logistics support capability of the Air Force would include primary and local air transportation, facilities (Section 4.4.3), personnel, supplies, field support services, communications equipment and photo reconnaissance. The support role of the Air Force would be particularly valuable in the Arctic regions due to experience in maintaining DEW Line Sites along the Arctic Coast and established search and rescue capability in the Arctic regions. The Air Force has primary or support responsibility for logistics in all search and rescue operations on the mainland of Alaska and offshore in the Arctic.[2]

Air Force aircraft based in Alaska that could be used for primary logistics support to oil spills state-wide include:

- C-118 (Liftmaster)
- C-124 (Globemaster)
- C-131 (Cargomaster)
- C-130 (Hercules)
- HH-3 helicopter

Air force planes are stationed at either Elmendorf or Eielson Air Force Bases near Anchorage and Fairbanks, respectively. The C-124 aircraft will be phased out in the near future.[3] Approximately 20 Air Force C-130's are stationed in Alaska. Several of the C-130's are ski-equipped. The C-130N aircraft have an established capability for in-flight refueling of specially-adapted HH-3 helicopters. Approximately three of the HH-3's equipped with the nose probe required for in-flight refueling will be operational in the future.[2] Four HH-3 helicopters are the specially-equipped "Rescue Birds."

The capability to refuel HH-3 helicopters in-flight with C-130-N aircraft is not widely used in Alaska by the Air Force. The nose probe has been removed from three of the original six helicopters thus equipped because of the weight penalty (approximately 1500 lbs.). The capability for in-flight refueling in Alaska is potentially of more value to Coast Guard aircraft because the HH-3 helicopters from Kodiak are often flying over the water or into regions where fuel is unavailable.

Air Force facilities in Alaska that could be used as supply depots or staging areas are described in Section 4.4.2. The support capability available from the Air Force for oil spill response logistics would encompass virtually every facet of primary transportation, local air transportation, communications and personnel support. Commissary items, survival gear,

fuel, medical supplies and services, and four-wheel drive vehicles are readily available from either Elmendorf or Eielson Air Force Bases. Similar support functions are potentially available from DEW Line Sites in the Arctic on a much more limited basis.

U.S. Army

The logistics support capability of the Army would include primary air transportation (with large helicopters), local air and land transportation, personnel, facilities (Section 4.4.2), field support services, supplies and communications equipment. The Army has an established capability for Arctic search and rescue on the mainland and in the Arctic regions. The major Army bases are located at Fort Richardson near Anchorage and Fort Wainwright near Fairbanks. The Army also has an Arctic Test Center at Fort Greely (southwest of Fairbanks).

Army aircraft are primarily based at Fort Richardson (Bryant Field) and Fort Wainwright. Aircraft available include:

Helicopters

- CH-47 (Chinook)
- CH-54 (Skycranes)
- UH-1 (Huey)
- AH-1G (Cobra Gunships)
- OH-58 (Kiowa)

Fixed Wing

- OV-1 (Mohawk)
- U-21 (King Air)
- O-2 (Skymaster)

The larger helicopters (CH-47 and CH-54) are generally operated from Fort Wainwright because maintenance facilities are located there.[3]

The Army has various types of half-tracked, full-tracked, four-wheel drive, and amphibious vehicles available at Fort Richardson, Fort Wainwright and Fort Greeley. Specifications on these vehicles are included in Appendix A. The Army Cold Regions Research and Engineering Laboratory at Fort Wainwright maintains a limited number of smaller All Terrain Vehicles (ATV's) for research purposes. The largest of these vehicles is a full-track Nodwell, manufactured in Canada (See Appendix A).

The Army facilities at Fort Wainwright, Fort Richardson, or Fort Greeley could serve as either supply depots or staging areas for oil spill response. Field support services, paramedics, shelters, survival gear, communications equipment, commissary supplies, and personnel are also available at the bases.

U.S. Navy

The Navy has essentially moved all military operations to Adak Naval Air Station in the Aleutians since leaving the Kodiak Naval Air Station in the early 1970's. The only logistics support functions felt of value to onshore or near offshore oil spills would be in the areas of long-range communications or photo reconnaissance. The P-3 (Orion) is commonly used for photo reconnaissance in Alaska.

The Naval Arctic Research Laboratory (NARL) at Point Barrow has served for many years as a staging base for research operations in the Arctic. Personnel at the NARL have expert knowledge relating to outfitting for Arctic field operations and the limitations imposed by the environment, both onshore and offshore. A few small ATV's, bulldozers, and utility vehicles such as four-wheel drive pickups are maintained at the Laboratory. A C-47 and approximately two smaller single engine aircraft are also maintained at Point Barrow.

The Office of Naval Petroleum and Oil Shale Reserves administers the Naval Petroleum Reserve #4 (NPR #4) on the North Slope.[4] A small amount of seasonal exploration and maintenance of facilities throughout the NPR #4 is accomplished by civilian contractors working out of Point Barrow. During the summer of 1973, two Rolligons (See Appendix A) were being used on the NPR #4 for service work to areas such as Umiat.[5] The trip between Point Barrow and Umiat required several days. The Rolligons are always sent in pairs on trips spanning considerable distances to protect against the possibility of breakdown and resultant stranding of the occupants.

4.2.2 Bureau of Land Management

The Division of Fire Control of the Bureau of Land Management has a very large, permanently established emergency response capability within Alaska for fighting fires. The BLM protects approximately two-thirds of the state's land area from wildfire and has responsibility for action on most of the forest fires on the mainland.[6] Many parallels exist between response to forest fires and response to oil spills, particularly in Alaska. There are also significant differences, primarily in that forest fires are normally seasonal and several can start simultaneously when lightning storms occur over broad areas.

The Bureau of Land Management has compiled a comprehensive Fire Control Action Plan that will be described in detail in the following paragraphs. Many of the procedures and policies could be applicable to oil spill logistics response in Alaska. The possibility also exists that direct use of the BLM organization and logistical support capability could be made by the Coast Guard, particularly during the period of lower fire probability (October-May).

The primary objectives of the Fire Control Action Plan are:[7]

- To provide a basis for consistent evaluation of control priorities between districts
- To establish a system of priorities which is readily translated for operational use
- To place the BLM and its fire managers in a defensible position with respect to expenditures of fire suppression moneys

The Division of Fire Control has divided the mainland of Alaska into two districts--Fairbanks and Anchorage. Each

district is further divided into three fire control areas. A series of primary fire control attack bases have been established throughout the areas where high probability for fire exists (Figure 4-1). A series of secondary fire control attack bases have also been established that cover the areas between and on the fringes of the primary attack bases. (Figure 4-2) A summary of the fire control attack system bases is shown in Table 4-3.

Priority for fire control response and the level of effort is based on a set of land or resource values. The land area of Alaska has been classified within one of five land value classes. The lower classifications are comprised of areas having no special or unique resource values and areas where the fire is surrounded by natural barriers. Higher classified areas include those where improvements, industry or personal property is at stake. The high classification is reserved for those areas where significant threat exists to human life in the event of fire. Areas of special scenic, wildlife or resource value receive a relatively high priority classification.

The Fire Control Action Plan was originally formulated on a set of assumptions upon which various provisions of the plan could be based. The original assumptions that might relate to oil spill response are cited below:[7]

- The plan assumes that the number of men deployed in the field on fires is the simplest existing index to the extent of commitment at any given time.
- There is a limit to the maximum number of personnel which may be deployed on fires at any one time statewide, and this limit is determined by efficiency, which decreases as the magnitude of the operation increases. Fifty men in the field presents no problem. Five thousand

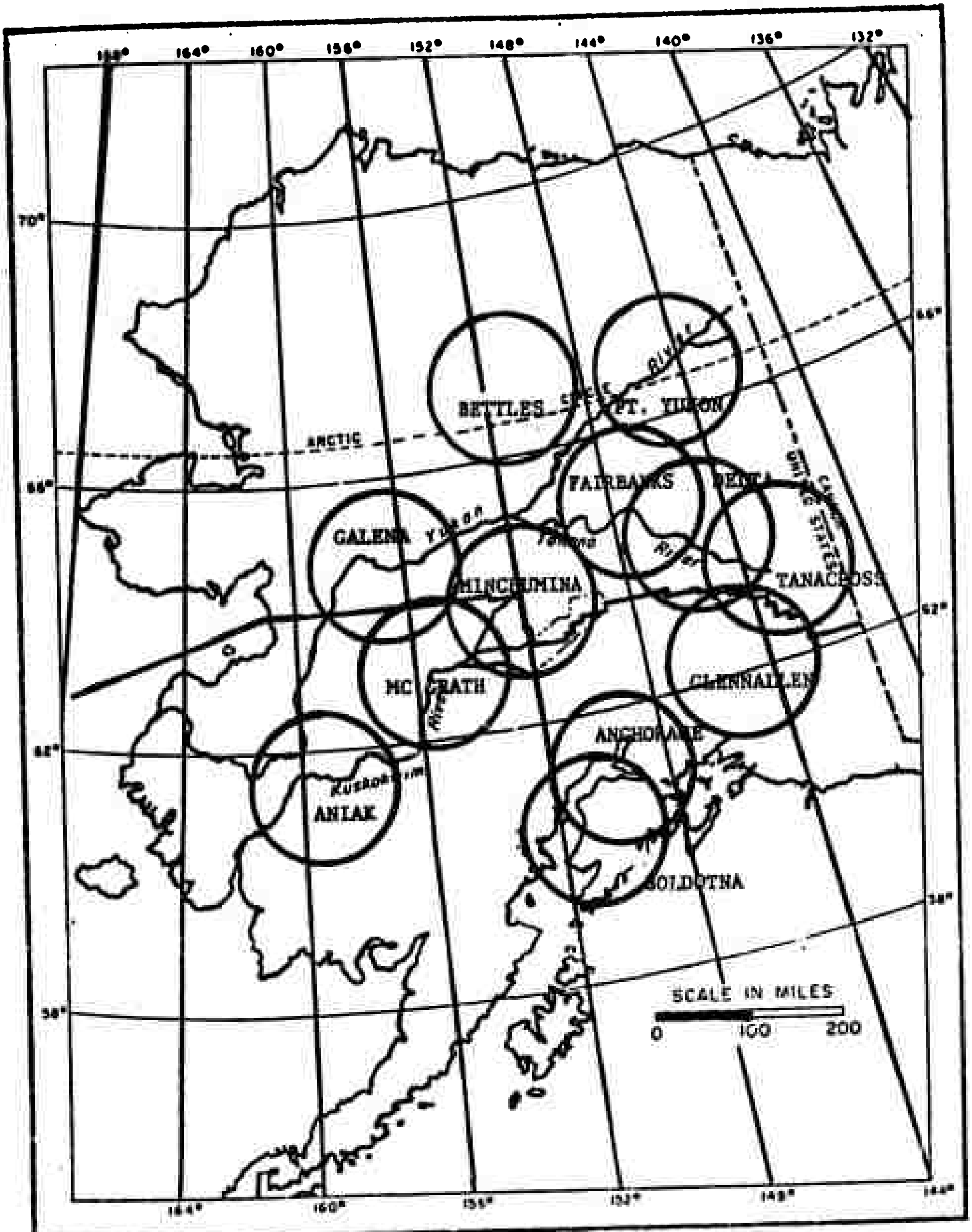

FIGURE 4-1. PRIMARY ATTACK BASES OF ALASKA FIRE CONTROL SYSTEM

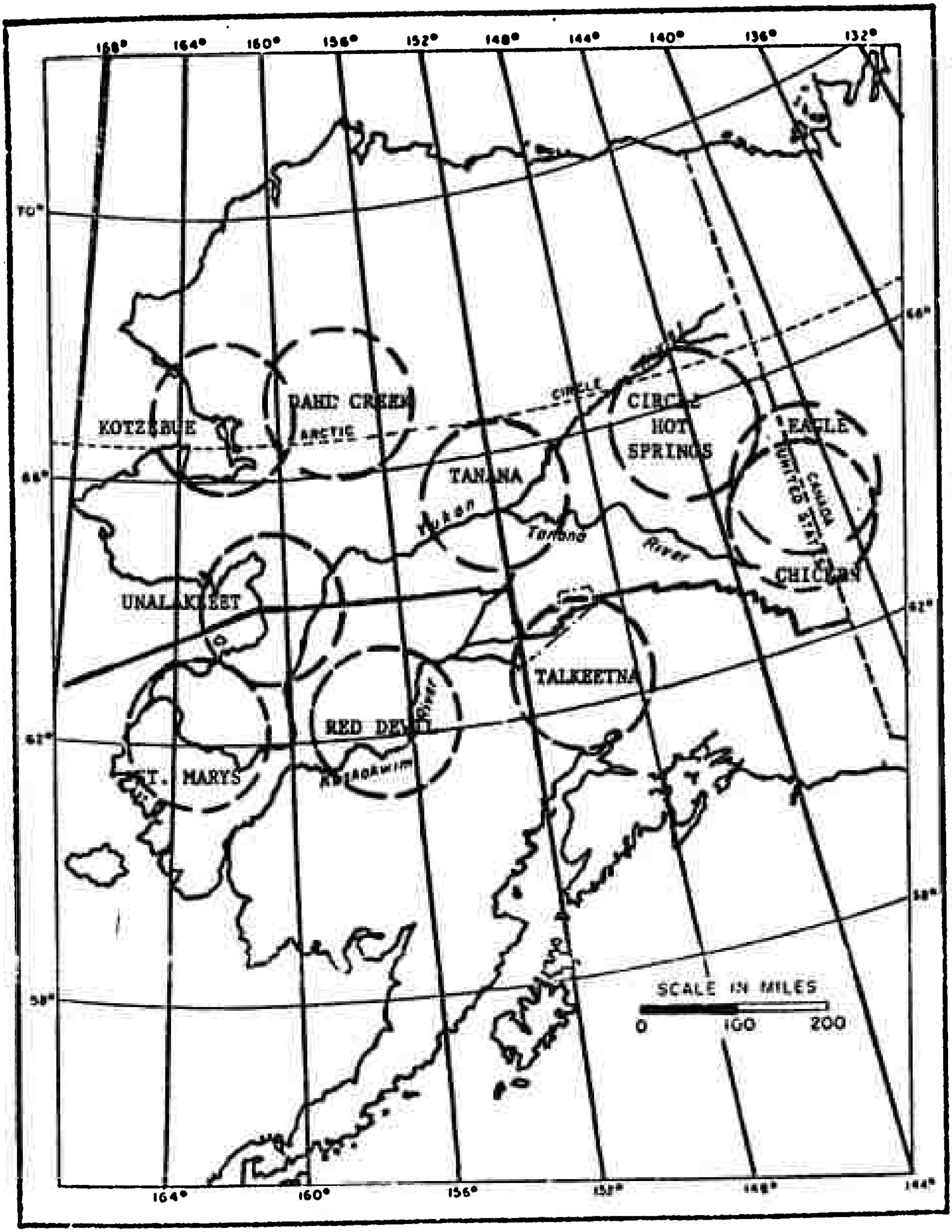

FIGURE 4-2. SECONDARY ATTACK BASES OF ALASKA FIRE CONTROL SYSTEM

TABLE 4-3.

SUMMARY OF ALASKA FIRE CONTROL ATTACK SYSTEM

District	Attack Site	Type Base	Retardant	Type Attack Helitack	SJ	Ground T.
Anchorage	Anchorage Hdqts.	P	S	P	S	P
	Soldotna	P	P	S	S	P
	Glenallen	P	S	P	S	P
	Minchumina	P	-	P	S	-
	McGrath	P	P	P	S	-
	Aniak	P	S	P	S	-
	Cantwell	P	-	-	-	P
	Talkeetna	S	-	S	S	S
	Unalakleet	S	S	S	S	-
	St. Marys	S	-	S	S	-
	Red Devil	S	-	S	S	-
Fairbanks	Fairbanks Hdqts.	P	P	P	P	P
	Big Delta	P	S	S	S	P
	Tanacross	P	P	P	S	P
	Fort Yukon	P	P	P	S	-
	Bettles-Prospect	P	P	P	S	-
	Galena	P	P	P	S	-
	Livengood	P	-	S	-	P
	Healy	P	-	S	-	P
	Circle Hot Springs	S	-	S	S	S
	Tanana	S	S	S	S	-
	Dahl	S	-	S	S	-
	Kotzebue	S	S	S	S	-
	Eagle	S	-	S	-	S
	Chicken	S	-	S	-	S

P. Primary
S. Secondary
SJ. Smoke jumpers

men deployed in the field would result in chaos since most normal limiting factors such as span-of-control would have long since been exceeded. Somewhere between these extremes is a figure which really represents the maximum extent to which we may commit ourselves under our present organizational circumstances, and still conduct an acceptably efficient operation.

- There is a limit to the amount of money and effort which should prudently be spent on project fires occurring on low value lands, regardless of the overall fire situation.

The Fire Control Division can mobilize up to 2,000 men to fight fires statewide. Transportation and logistic support for the response is provided by either prearranged contracts or rentals of aircraft owned by private industry. The aircraft charter companies are guaranteed a contract minimum and are paid on an hourly basis for air time accumulating beyond the minimum. Table 4-4 is a summary of the rental aircraft available by either contract or rental during the summer period of CY 1974:[8]

Land vehicles are available at the primary attack bases throughout the State where a road system exists. A limited number of All Terrain Vehicles (ATV's) with capability to operate in snow or on the tundra are stationed at the primary attack bases and at supply centers in Anchorage and Fairbanks.

The manpower normally required to fight fires comes from a combination of permanent BLM employees, standby crews pre-recruited from Alaskan villages and from the Lower 48 (mainly smokejumpers from the Boise Interagency Fire Center). Table 4-5 is a summary of Alaskan villages in which trained firefighting personnel are available.

TABLE 4-4

SUMMARY OF RENTAL AIRCRAFT AVAILABLE TO BLM DURING CY 1974

Type of Aircraft	Number	Cost Per Flying Hour ($)	Function
250 A1	9	180	Helitack
Light Twin	14	30	Detection
Queen Air	1	-	IR Detection
DC-3	2	120	Smokejumping
Volpar	1	450	Smokejumping
PBY Super	2	450	Aerial Tanker
DC-6	2	700	Aerial Tanker
C-119	1	500	Aerial Tanker
Navajo	1	90	Chase Plane
Grumman Goose	2	140-180	Light Transport (Rental)
206 B	1	90	Helitack
PB4Y-2	2	500	Aerial Tanker
Argosy	1	975	Heavy Transport
DC-6	1	750	Heavy Transport
C-46	1	240	Heavy Transport
Lear Jet	1	552	Detection

TABLE 4-5

ALASKAN VILLAGES WITH TRAINED FIREFIGHTERS

Alakanuk	Mountain Village
Allakaket	Nenana
Ambler	New Stuyahok
Anaktuvuk Pass	Nikolai
Arctic Village	Noatak
Buckland	Nondalton
Chalkyitsik	Noorvik
Chevak	Northway
Eagle	Nulato
Emmonak	Pilot Station
Fort Yukon	Point Hope
Galena	Ruby
Grayling	Scammon Bay
Holy Cross	Selawik
Hooper Bay	Shaktoolik
Hughes	Shishmaref
Husila	Shungnak
Iliamna	Stebbins
Kalskag	St Mary's
Kaltag	St Michael
Kiana	Tanacross
Kivalina	Tanana
Koyuk	Tetlin
Koyukuk	Unalakleet
Manokotak	Venetie
Minto	

The Bureau of Land Management maintains a Logistics Support Center for fire control at the Boise Interagency Fire Center at Boise, Idaho. The center has tools, equipment, and supplies available for all Federal agencies and those agencies having mutual assistance agreements with Federal agencies. Equipment available includes field communication radio kits, food service, aircraft and temporary airport control towers. The equipment pool is heavily used during the peak fire season in the summer but underutilized during the remainder of the year (October-May).[9] The equipment might be made available to the Coast Guard in Alaska during low fire probability seasons by prior agreement.

The BLM has cooperative agreements with the Military, other Federal agencies, the State of Alaska, and Canada which greatly enhances the fire control capability in Alaska. Table 4-6 is a summary of the more pertinent of the cooperative agreements.[7]

TABLE 4-6

SUMMARY OF BLM INTERAGENCY AGREEMENTS

Agency	Provisions
Corps of Engineers	Use of space and/or buildings at Fort Wainwright, Allen Army Air Field, and Camp Carroll.
United States Army	Mutual cooperative agreement to provide emergency forest fire fighting support on a reimbursable basis.
United States Air Force	Alaska Air Command to provide logistical support for BLM. Support includes clothing, communications, vehicles, fuel, housing, medical/dental, messing, and transportation. Alaska Air Command may also request fire fighting support from BLM.
Alaska Railroad	Plan of action and mutual assistance in fighting fires.
United States Forest Service	Mutual agreement for presuppression and suppression on a cost reimbursable basis.
Bureau of Sports Fish and Wildlife	BLM to provide assistance in suppressing wildfires on BSF&W land.
Federal Aviation Agency	Grants BLM use of buildings and vehicles.

(Table 4-6 continued)

Agency	Provisions
National Park Service	Presuppression and suppression activities on public domain land adjacent to National Park or Monuments.
Bureau of Indian Affairs	BLM responsible for fighting wildfires on all lands administered by BIA. BIA will assist when possible.
National Weather Service	NWS will provide upper air soundings, radar observations, data processing, daily briefings at BLM. BLM will provide weather observations, BLM teletype, communications, air transportation, agreement for radar sites, one meterological technician, and take care of personnel doing upper air soundings.
State of Alaska	BLM presuppression and suppression on state lands.
Mutual Aid	City of Fairbanks and Anchorage and Anchorage International Airports, Ft Wainwright, Eielson AFB, North Pole Fire Dept, University of Alaska Fire Dept, Anchorage Borough, Alaska National Guard, Fort Richardson, Elmendorf AFB and BLM. Mutual aid in the event of major fires,

(Table 4-6 continued)

Agency	Provisions
	aircraft crashes, to result in saving human life and property.
Canadian Agreement	Cooperative agreement between Canada and United States in detection and suppression of fires along the buffer zone - 10 miles in depth on each side of boundary.

4.2.3 Other Federal Agencies

Federal civilian employment in Alaska was approximately 17,000 in 1969.[1] Federal civilian employees and installations are generally more dispersed state-wide than military personnel and installations. Table 4-7 is a summary of the Federal agencies in Alaska which are felt capable of contributing logistic support or expert advice to the Coast Guard for oil spill response.

The diverse nature and lack of large transportation vehicles would severely limit the potential for primary logistics support from outside Federal agencies, on a state-wide basis, with the exception of the Bureau of Land Management Fire Control Division. Various Federal agencies could potentially support the Coast Guard in the areas of personnel, specialized equipment (such as communication gear), facilities, local transportation and field support services. The more valuable potential contribution from Federal agencies is felt to be in the areas of facilities for staging bases and personnel with expert local knowledge. Personnel with intimate knowledge of local transportation availability or restrictions and the availability of supplies would be invaluable to the Coast Guard On-Scene Commander at certain spill locations. The following paragraphs discuss selected Federal agencies that could provide limited logistic support to the Coast Guard Facilities for staging bases are covered in Section 4.4.4.

U.S. Forest Service

The U.S. Forest Service administers two National Forests within Alaska - Tongass National Forest in southeast Alaska and Chugach National Forest in the south-central area of the mainland. Headquarters at Cordova and Seward are located near areas of high oil spill probability. Field supplies, personnel

TABLE 4-7

FEDERAL AGENCIES IN ALASKA
WITH POTENTIAL FOR LOGISTIC SUPPORT

Department of Agriculture

U.S. Forest Service

Department of Commerce

Environmental Sciences Service Administration (ESSA)

National Oceanic and Atmospheric Administration (NOAA)

National Weather Service

Environmental Protection Agency

Federal Communications Commission

Department of the Interior

Bureau of Indian Affairs

Bureau of Land Management

Fish and Wildlife Service

National Park Service

Department of Health Education and Welfare

Public Health Service

Department of Transportation

Alaska Railroad

Federal Aviation Agency

General Services Administration

and land vehicles would be available at these locations. The Park Rangers would have expert knowledge of the possibility of and best routes for local overland transportation.

National Weather Service

The National Weather Service maintains offices in the following cities and towns:

Anchorage	Juneau
Barrow	King Salmon
Barter Island	Kotzebue
Bethel	McGrath
Cold Bay	Nome
Fairbanks	

Personnel at these offices could coordinate weather predictions and would have knowledge about the effect of local environmental conditions on primary or local transportation.

Federal Aviation Administration (FAA)

FAA had stations at the following locations within Alaska in 1970:(1)

Anchorage	Gulkana
Aniak	Homer
Annette	Illiamna
Bethel	Juneau
Big Delta	Kenai
Cold Bay	King Salmon
Bettles	Kodiak
Cordova	Kotzebue
Fairbanks	McGrath
Farewell	Nenana
Fort Yukon	Nome
Galena	Northway

Further stations have since been established or will be added along the Trans-Alaska Pipeline route at locations such as Prudhoe Bay and Valdez.

The FAA station administrators and personnel could serve to coordinate aircraft traffic and communications and would have expert knowledge regarding local flying conditions. The FAA has portable aircraft control towers available in the "Lower 48" states. The nearest is in Seattle. Portable control towers are not yet available from the FAA in Alaska. A limited supply of land transportation vehicles and field supplies would be expected at most stations.

Fish and Wildlife Service

The Fish and Wildlife Service administers Wildlife Refuges throughout the state. Regional and local Wildlife Management Offices are located in the following cities and towns:

Anchorage	Kenai
Bethel	Kodiak
Fairbanks	Kotzebue
Cold Bay	

The Fish and Wildlife Service has agent-pilots available that conduct wildlife surveys. These personnel would be expert advisors with respect to local transportation requirements and access problems.

The Fish and Wildlife Service maintains ships and aircraft for wildlife surveys. A converted Grumman Goose (amphibian) and smaller aircraft are stationed in Anchorage that could be used for limited primary logistic support and also local transportation.

National Marine Fisheries Service

The National Marine Fisheries Service has laboratories at Auke Bay and Kodiak and a field station near the head of

Bristol Bay. The NMFS operates research vessels throughout the Gulf of Alaska and the Bering Sea, mostly during the summer season. The Fishing Gear Research Base at Kodiak (located on the Kodiak Coast Guard Base) has field equipment such as nets and small boats that could be of value to the Coast Guard for marine oil spills.

4.2.4 State of Alaska

The State of Alaska has personnel and facilities spread state-wide at most cities and towns. Primary logistic support for oil spill response would be of limited value, with the exception of the Alaska National Guard. The potential is much greater for support in the form of facilities, personnel, field support functions and local transportation. The only state-owned transportation system is Alaska State Ferry System which serves all major cities in southeast Alaska and portions of the south-central mainland. State ferries connect Anchorage, Homer, Seldovia, Seward and Kodiak and also Whittier, Valdez and Cordova on Prince William Sound. Some of the runs are out of service during periods of the winter.

The Alaska Department of Fish and Game and Alaska State Police have offices and field stations distributed at virtually all major cities and towns in Alaska. The facilities could serve as staging areas and generally would have vehicles and boats available for local transportation. Personnel would be familiar with local access problems and knowledgeable regarding the availability of local supplies and services.

Alaska National Guard

The Alaska Air and Army National Guard has an established search and rescue capability within the state. National Guard aircraft stationed in the Anchorage area (at Anchorage International and Bryant Fields) include several C-123's (Providers)

and more than 30 UH-1H and UH-1M helicopters.[3] National Guard armories are located in the following areas:

Anchorage	Ketchikan
Bethel	Kodiak
Fairbanks	Nome
Juneau	Seward
Kenai	Sitka

In addition, there are small Eskimo Scout units and armories in 62 additional communities throughout the northern and western parts of the state.[1] Equipment and supplies available at these armories could provide supporting functions for field operations at nearby spills.

4.2.5 Petroleum Industry

The petroleum industry in Alaska is presently engaged primarily in the production and transportation of crude oil. There is only one refinery in the state. The transportation and distribution of refined products was approximately 16 million barrels in 1970.[11] Crude oil production for the same year was over 80 million barrels. The startup of the Trans-Alaska Pipeline in 1977 or 1978 will increase the rate of crude oil to refined products handled by nearly an order of magnitude.

Crude oil production is presently limited to the northern portion of Cook Inlet. The Prudhoe Bay field and areas of lower Cook Inlet are expected to be producing by 1978 and the early 1980's, respectively. Table 4-8 is a summary of projected crude oil production within the foreseeable future.[12]

Petroleum industry facilities are naturally concentrated near producing fields and transportation terminals. Exploratory drilling activities are the most notable exception and can be rather widespread at any given time.

TABLE 4-8

STATUS OF OIL FIELDS AND PROBABLE DATES OF PRODUCTION

Cook Inlet, Kenai Peninsula	Currently producing at 200,000 bbls/day and declining in present lease areas	Leasing of additional area expected in 1975 or 1976 Exhaustion of reserves expected in early 1990's.
Prudhoe Bay	1977-1978	Pipeline under construction. Completion anticipated in 1977.
Lower Cook Inlet	1980	State lease sales possible by about 1975, other in litigation.
Gulf of Alaska	1983-1985	Lease sale as early as 1975 or 1976. Eastern Gulf most favored area.
Bristol Bay	1985-1987	Lease sale possible in 1978.
Bering Sea Shelf	1990-	Yet to be explored.
Beaufort Sea (offshore)	1990-	Exploration underway in Canada. Federal and state lease sales possible by late 1970's.
Kotzebue Sound and Norton Sound		Current interest. Small lease sales possible before 1980.

The petroleum industry is generally prepared to contain and clean up spills occurring near production and transportation facilities. The industry is the best potential source of equipment for actual oil spill containment and cleanup. An oil spill cleanup cooperative exists in Cook Inlet (Cook Inlet Oil Spill Cooperative). A similar cooperative is being established by Alyeska to handle oil spills in Valdez and Prince William Sound. A similar oil spill cooperative will be developed by the Gulf of Alaska Operators Committee and become operational before drilling commences in the Gulf of Alaska.

The Cook Inlet Oil Spill Cooperative was described as follows in Council of Environmental Quality hearings.[13]

> "The expenses of the cooperative are shared by the members on the basis of an agreed upon formula based on such matters as the number of wells owned, the number of barrels refined, and the number of barrels transported by each member. Each member furnishes a list of equipment - pickup devices, skimmers, vacuum trucks and oil booms - that it will make available upon request. Similar lists are supplied to cover materials such as chemicals and absorbents and personnel such as operators for specialized equipment. Each member also supplies lists of names, addresses, titles and telephone numbers of its personnel who can most expeditiously supply the requested equipment and materials. All these personnel lists include business and home phone numbers as well as alternates in order to avoid delay due to any absences.
>
> All such items are immediately available to any member and to the United States Coast Guard. Under the agreement, if the source of a spill is not determined, then the Coast Guard will be in charge and will have the use

of the cooperative's equipment, materials, and expertise. On the other hand, if an individual member feels that its facility is the source of the spill, then that member can obtain these items from the cooperative; he can proceed immediately without worrying about the possibility that he may not be at fault after all but that his action might later be deemed to be some sort of an admission of guilt."

Oil spill cooperatives offer the best potential source of local logistics support to the Coast Guard because the equipment, materials and expertise are available to the Coast Guard by prior agreement. The independent operators at production and loading facilities will also have local transportation such as offshore work boats and helicopter services available if the spill is within the immediate area. The petroleum industry will not generally be well-prepared for long range or primary transportation support for most potential spills because long-range transportation is not commonly used. However, long-range transportation will be available during construction of the Trans-Alaska Pipeline. Offshore workboats will be common in the Gulf of Alaska over the next few years as exploratory drilling and production begin.

4.2.6 Fishing Industry

The fishing fleet within Alaska has, by far, the largest number and most diverse types of marine vessels available for logistic support in response to oil spills. The overall fleet numbers are in the thousands. Fishing vessels support would generally be limited to local transportation and field operations at or near the scene of the spill. Limited use could also be made of the boats to sustain or quarter personnel

in the field. Most fishing vessels are incapable of supporting more than three or four additional personnel beyond the normal crew. The use of fishing vessels for logistic support can be justified for any of the following reasons:

- The normally widespread distribution of these vessels in coastal areas of the Gulf of Alaska, southeast Alaska, and seasonally in Bristol Bay makes the probability very high that one or more vessels will be near the scene of the spill.
- The skippers of the vessels will, in all probability, be intimately familiar with vessel operation in the local waters.
- Vessels fishing in certain areas are specially-adapted for local conditions.
- The rigging and gear on some types of fishing vessels are particularly suited to oil spill cleanup operations.
- An effective and versatile system of marine communications exists between the fishing vessels and their home base.

The location and concentration of marine fishing vessels throughout the coastal areas of Alaska depends upon which fisheries are open, the catch predicted for the year and, to some extent, weather. The salmon fishery is highly seasonal both statewide and locally, running between June and September. The Bristol Bay red salmon fishery peaks around July 4th. During large runs, well over a thousand boats will be in the area. However, during years of poor runs (the red salmon season was closed in 1974) the number of vessels would be limited.

Fisheries for crab, shrimp and bottom fish generally extend over a much longer season in most areas. The larger vessels are engaged in these fisheries because most of the grounds are offshore. At present, the fishery for the combination of these species extends year-round in the Gulf of Alaska and Pacific Ocean west of Kodiak Island out to Unimak Pass. Local fisheries also exist nearly year-round in Prince William Sound and Lower Cook Inlet. Bristol Bay is fished most heavily during the summer season, but a limited fishery for King Crab exists the remainder of the year in ice-free waters.

The largest port of activity for fishing vessels on a year-round basis is Kodiak. Other major home ports in the Gulf of Alaska region include:

- Cordova
- Dutch Harbor
- Homer
- Sand Point (Shumigan Islands)
- Seward
- Yakutat

Table 4-9 is a summary of fishery cooperatives throughout Alaska during the 1969-1970 seasons.[1]

The Alaska domestic fleet cannot be adequately characterized by class or type of vessel because of the diverse nature and constantly changing types and number of vessels. None of the vessels can operate effectively in ice. The following paragraphs describe some generic types of vessels common throughout the state. The specifications of one of

TABLE 4-9

SUMMARY OF FISHERY COOPERATIVES THROUGHOUT ALASKA

Location	No. of Members	No. of Boats	Type of Fishery and comments
Anchorage	90	200	Mainly salmon
Angoon	108	27	Salmon
Barrow	48	None	Consumers union
Bethel	-	-	Small river outboards
Cohoe (Kenai)	128	128	Halibut and salmon
Cordova	500	450	Clams, crabs, and salmon
Dillingham	505	425	Salmon (mainly gillnetters)
Emmonak	60	na	Salmon
Homer	na	na	King crab, salmon, shrimp
Hydaburg	176	13	Salmon
Kake	na	19	Salmon
Klawock	212	14	Salmon
Kodiak	457	387	King crab, salmon (many large vessels)
Metlakatla	200	28	Salmon
Petersburg	80	80	Halibut, King crab, salmon

the more modern combination vessels (shrimp/crab/bottom fish) found throughout the Gulf of Alaska appears in Appendix A.

The largest and most modern vessels in the Alaskan fleet are generally the offshore trawlers and crabbers. Most are between 70 and 100 feet LOA and can carry between 150,000 and 300,000 pounds of product. A large open work area generally extends from approximately midships to the stern. Hydraulic-powered booms with capacities up to about five tons are common, if not universal. The newer trawlers are equipped with a stern ramp to facilitate dragging nets aboard. Many of the trawlers also are equipped with 40 foot outriggers on each side to permit dragging of two trawls (identical to double-rigged Gulf of Mexico shrimp trawler). Both of these features (stern ramp and outriggers) would make this type of vessel very well suited for containing and cleaning up marine oil spills. The larger boats can fish effectively in waves up to six or eight feet.

The salmon fishery is seasonal (June-September) and concentrated around major river outlets along the entire coastline between southeast Alaska and the Yukon River. The generic types of vessels found in this fishery include:

- Gillnetters - generally under 35 feet
- Purse Seiners - generally under 60 feet
- Beach Seiners - generally under 30 feet
- Trollers - generally under 35 feet LOA
- Cannery tenders - generally over 75 feet

The purse seiners would appear particularly well-adapted to either local oil spill response logistics support or cleanup operations. The larger purse seiners carry a rapidly

deployable seine skiff that is fast, rugged and powerful. These open skiffs range up to lengths of approximately 20 feet and are used to hold and close one end of the seine. The handling and deployment of oil containment booms is nearly identical to the setting and closing of a purse seine. The generally smaller beach seiners operate seines that have one end attached to the shore initially. The propellers of the beach seiners are thus located in tunnels or are otherwise extremely well protected to permit operation of the vessels right up to the shore. The beach seiners could be invaluable for operations and beach access along otherwise inaccessible coastlines.

Fishing vessels are normally owned or under contract to local canneries. Thus, the cannery operators are the most knowledgeable about the locations of the various vessels at any specified time. The radio network schedules have been mutually arranged to permit contact with each boat at least once or twice daily. The larger vessels generally have Citizens Band equipment aboard to permit contact between boats operating in the same general area.

Alaskan villages along the coastline of the northern Bering Sea, Arctic Ocean and rivers of the interior can be considered in roughly the same light as the fishing industry, only on a smaller scale. Small portable boats are available that are well-suited to local waters. The Eskimos have historically operated skin boats along the fringes of the seasonal ice. The boats used for fishing rivers of the interior such as the Kuskokwim are well-adapted to local conditions. Eskimos are commonly hired in the arctic regions for construction and other field activities because of their

unique ability to survive and perform useful work under the most adverse of conditions.[14]

4.2.7 Other Private Industry

The primary potential support function from other private industry is that of air transportation. Both scheduled airlines and charter aircraft might be used. Many other types of field support equipment and services are potentially available from a wide variety of private sources. However, keeping an updated compilation of equipment available in each region would be a monumental task.

Anchorage and Fairbanks are the major international airports within the state. The principal trunk airports are:[1]

Aniak	Ketchikan
Annette Island	King Salmon
Barrow	Kodiak
Bethel	Kotzebue
Cold Bay	McGrath
Cordova	Nome
Dillingham	Petersburg
Galena	Sitka
Haines	Unalakleet
Homer	Wrangell
Hoonah	(Valdez)
Juneau	(Prudhoe Bay-Deadhorse)
Kenai	

The larger domestic airlines serving points within Alaska include:

Alaska Airlines, Inc.
Reeve Aleutian Airways, Inc.
Wein Consolidated Airlines
Kodiak Airways, Inc.
Interior Airways

Aircraft commonly used for intrastate routes such as F-27's and 737's normally have expanded air cargo sections in the forward section that accomodate "Igloo" shipping containers. The containers have a capacity of approximately 4,000 pounds and most trunk airports within Alaska have the capability to load and unload these containers. Private companies such as British Petroleum have purchased "Igloo" containers to facilitate air shipment to virtually any point within the state. The advantage of standard containers is the fact that all airlines can readily handle them.

Charter aircraft and air taxis are common throughout the state. The larger charter companies operate all sizes of aircraft up to C-130 Hercules. Helicopters of many types and sizes are available for operations near the larger cities and towns. During the winter of 1969-1970 over 80,000 tons of cargo were airlifted to Prudhoe Bay on a round-the-clock-basis.[1] The air cargo was carried primarily by C-130 Hercules. All companies participating in this airlift gained invaluable experience in flying during the winter in the Arctic.

Construction and equipment rental companies located in or near the major cities and towns have the normal range of trucks, ATV's, earth moving and other construction vehicles available. Private companies in Anchorage and Fairbanks also have portable field camps available for sale or rent.

Several barge lines operate between major marine ports within the state and also along the larger rivers such as the Yukon and Kuskokwim. The barges are particularly suited for transport operations in the shallower waters that exist along the entire coastline of the Bering Sea and Arctic Ocean. The barges also serve well as working platforms at marine spill sites.

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13. Testimony by Howard A. Slack of the Gulf of Alaska Operators Committee before the Council on Environmental Quality, Anchorage, Alaska, Sept. 26 and 27, 1973.

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4.3 TRANSPORTATION ELEMENTS POTENTIALLY AVAILABLE OR UNDER DEVELOPMENT

Modes of Conveyance for rapid response to oil spills have been divided into three generic classifications: aircraft, land vehicles and vessels. Surface Effect Vehicles (SEV's) are included within the category of land vehicles, although some justification exists for separate categorization. The many somewhat unique constraints upon SEV operation in Alaska are felt to relegate the performance closest to that of land vehicles from a logistic support standpoint. Current SEV's cannot compete with conventional ships in the heavy seas and icing conditions found in the Gulf of Alaska and Bering Sea nor can SEV's compete with helicopters in flying over the rugged terrain existing along much of the state's coastal area. SEV's are discussed below in a separate section because of the distinct advantages for transportation over flat Arctic terrain and sea ice.

Two general conclusions can presently be drawn regarding response vehicle requirements:

- Fixed-wing aircraft are essential for long range transportation
- Helicopters are the only vehicles capable of traversing virtually any surface feature

The suitability of response vehicles for rapid primary transportation and local or secondary transportation support can be quantified to a certain extent in terms of range. The capability of the various types of vehicles for the range categories shown below are based upon both dash speed and range without refueling for typical Alaskan response conditions:

Long range - more than 600 nautical miles

Fixed-wing aircraft

<u>Intermediate range</u> - 100-600 nautical miles

Helicopters
Land vehicles (conventional)
SEV's
Fixed-wing aircraft
Large vessels (cutters)

<u>Short range</u> - 20-100 nautical miles

Helicopters
Land vehicles (conventional)
SEV's
Fixed-wing aircraft
Large vessels (cutters)
ATV's or off-road vehicles
Small vessels

<u>Local transportation</u> - up to 20 nautical miles

Helicopters
Land vehicles (conventional)
SEV's
Large vessels (cutters)
ATV's or off-road vehicles
Small vessels

Long range transport was defined as distances spanning more than 600 nautical miles because that is the approximate distance that High Endurance Cutters can travel in 20 hrs at maximum speed and also the maximum range of helicopters. The distinction between the short and intermediate range is more arbitrary and is included primarily to point out that vehicles with a maximum speed under approximately 10 knots are of little value for response at distances over 100 nautical miles using the criterion of a 10-hour response time for open water spills.

Local transport requires a much more flexible class of vehicles due to the environmental transition zones normally

encountered and the advantages gained if the vehicle can perform more than one field support function. Ideally, vehicles for local transportation would at least partially fulfill the following support functions:

- Serve as a communication center
- Personnel and/or heavy equipment transport
- Provide living quarters for personnel
- Provide a working platform for oil cleanup efforts
- Provide a medical center
- Serve as a fuel depot or source
- Be light and readily transportable by primary conveyance vehicles
- Towing of sleds

The succeeding sections contain descriptions of the vehicles felt potentially available, now or in the future, for the transportation functions described above. Detailed specifications of the vehicles appear in Appendix A.

4.3.1 Land Vehicles

Land vehicles suited to Arctic or sub-Arctic operation are normally driven by either wheels or tracks. The vehicles can be classified into eight groups according to their running gear:[1]

Archimedian screw vehicles
Propeller ski vehicles
Half-tracked vehicles
Full-tracked vehicles
Wheeled vehicles
Air roll vehicles
Air supported vehicles
Articulated tracked vehicles

The following observations of performance in Canada of various vehicle groups were presented by Harwood and Yong at a conference in 1972:[1]

Archimedian Screw Vehicles

Whilst no analystical solution for the pull-slip curves for the screw is available, the action of the screw at low speed however can be compared to the action of a track. In either case the soil may be assumed to be trapped by the screw blades and grousers and moved longitudinally with reference to the supporting surface. No rigorous confirmation has been made of this theory under a number of environmental conditions, and so far no screw vehicle has proved practical.

Propeller Ski Vehicle

The ski-borne air-propeller driven machine has numerous drawbacks which keep its application to either extremely light machines or to areas where snow conditions and level ground limit the maximum thrust-to-weight ratio to around 0.2. For all-round service, together with the ability to master reasonable grades, such machines would require the installation of approximately 305 h.p. per ton. This is approximately the requirement for the present-day five passenger helicopter. Thus, from the aspect of fuel consumption and payload to gross weight, this type of vehicle does not appear to be practical.

Half-tracked Vehicles

The combination of the ski and track in small machines is an attempt to utilize the ski without the high power-to-weight ratio necessary for air-screw ski propulsion. A similar example consists of the light load-carrying sled toboggan, propelled by a small floating rack unit mounted

usually between the sliding surfaces and carrying about 50 percent of the gross load. The success of these machines depends entirely on keeping on the top of the snow cover so that motion resistance and tractive requirements are kept to a minimum. The extremely low unit ground pressure required to operate these vehicles over snow is a prime restriction in regard to their development into a true load-carrying machine.

There are several machines, however, which use the ski in combination with a true load-carrying track. Since only enough weight is carried on the skis to provide steering, these vehicles are essentially tracked vehicles with ski steering substituted for track (locked tracks) steering. This is in some ways a desirable feature for it eliminates the "digging-in" which occurs in soft snow when track steering is used. Because of mobility limitation imposed by the ski or wheel on rough ground in the summer, however, these vehicles are obviously limited.

Full-tracked Vehicles

The most successful class of self-propelled vehicles are the full-track laying type. While these vehicles may not have high mobility in snow; nonetheless, for economic reasons, they appear to partially fulfill the requirements for a general purpose vehicle better than most other types. There have been several efforts to improve track design and in the 1950's a great deal of development was undertaken around small full-tracked vehicles using the "spaced-link" track; that is, a track with large spaces between the grousers and the links.

If the grousers are spaced such that the deformation zones associated with each grouser do not overlap, maximum traction can be developed. The track might well be called

the "open hole" track. By raising the belly of the vehicles to such an extent that they might be called "bellyless" vehicles, these full-tracked vehicles have shown superior drawbar performance. This is thought to be due mainly to the markedly reduced motion (rolling) resistance; i.e. the reduction of the bow wave seen in front of any tracked vehicle, and the basically different mode of shear in the snow or muskeg developed by this track in comparison to conventional tracks. The indications are that the improvement demonstrated can only be practically achieved in small machines (below 10,000 lb. gross).

Wheeled Vehicles

The use of ordinary wheeled vehicles in the sub-Arctic and Arctic is limited to cleared ice, snow and other prepared roads. Specialized wheeled vehicles with large-diameter, low-pressure tires have been tried with some degree of success in unprepared ground.

The Letourneau Snow Buggy, from which developed the Letourneau "Snow Train", was successfully tested on the Greenland Icecap, and the later version "Snow Train" was quite successful on the Arctic coastal plains of Alaska and north-western Canada. A steel wheeled vehicle has also been tested in the muskeg around Fort Churchill where it proved to be the only vehicle capable of crossing certain areas. The steel wheels, however, are difficult to maintain and for this reason have not been exploited.

The Rolligon so far has not proved to be a successful over-snow vehicle in the undisturbed snow found within the northern coniferous forest. The Rolligon is a standard military pattern vehicle (U.S.) modified in such a way that the front wheels are replaced by a large balloon bag

filled to 3 psi. The two rear wheels are similarly modified. This vehicle operates on the concept that the balloons, deflated to less than 3 psi, can assume the shape of an ellipse and the shape of the lower side of the part of the ellipse can in effect be considered to have the properties, so far as the soil is concerned, of a very large-diameter (15-20 ft.) tire. By this means nominal ground pressure is further reduced and rolling (motion) resistance is lowered.

Articulated Vehicles

Wheeled and tracked vehicles can only sustain maximum drawbar pull at some percentage of slip between the track and the soil. When a vehicle is operating with both tracks developing a maximum pull at optimum slip, anything which moves either one of the tracks down on either side of the pull slip curve tends to immobilize the vehicle. The pull slip curve is far more pronounced in cohesive soils than in non-cohesive soils, with the result that immobility occurs more frequently. Thus no matter what the vehicle, so long as it is differentially steered, the ultimate in continuous drawbar pull is seldom achieved. The solution is to use a broken-back vehicle (articulated) designed in such a way that all four tracks are in contact with the soil and all tracks run at the same speed (or slip). This means that the front part of the vehicle with respect to the rear part must be free to move with three degrees of freedom (roll, pitch and steer).

The commonest concept of an articulated vehicle is of two vehicles of mirror image coupled together by a universal joint, driven by one motor through an articulated shaft. This has certain disadvantages, the main one being

the splitting of the vehicle and the complicated drives. To offset this disadvantage various manufacturers have produced variations of the concept. One such concept allows the track to be coupled to a rigid frame, much like bogies in a railroad car, the other like a fifth wheel truck trailer but with the trailer wheels driven and having two degrees of freedom. Both types of vehicles are now commonly used in the North.

Air Roll Vehicles

The air roll type of vehicle rides on wide pneumatic tires linked together by a continous chain. On hard ground the track wheels roll between the ground and the roller support with an overdrive of 2:1, i.e. the ground speed of the vehicle is twice the track chain speed. In soft ground the rollers stall and act as large cylindrical track grousers while the wheels now slide on the roller support.

Necessarily, these vehicles have a highly complicated and vulnerable track system and for this reason their commercial applications have been limited.

Non Self-Propelled Vehicles

Perhaps the most highly developed sleds as regards supsension and frames, certainly in North America, were Canadian Army "Northland" sleds. These were spring-mounted runners and of aluminum construction. The aim of this type of runner is to obtain better conformance to irregularities in the snow-covered terrain.

These sleds were developed for 2-ton and 4-ton loads. A sled or ski configured vehicle would on the surface appear to be a relatively simple vehicle to design.

Besides the complexity of the snow surfaces, however, there are other considerations which further complicate the problem. These considerations all revolve around the frictional properties of snow against a sliding surface. As in all sliding surfaces, involved are starting friction and sliding friction. In snow these parameters are complicated by the many factors associated with the development of starting and sliding frictions of snow. It is clear that with the changes in properties of snow with time and temperature, these would affect the mechanical response characteristics of the material.

The problem of design, and selection of the optimum size, shape and suitable materials for a sled or runner, is quite as complex as that of designing an over-snow vehicle. It is obvious that the major drawback to sleds is, of course, that they cannot be used except on ice and snow. Assuming, however, that there is a requirement for a towed sled, there exists the task of assessing the optimum power (drawbar pull) of the tractor against the load to be pulled.

Many Arctic vehicle designs have reached the advanced development or prototype stage and subsequently been dropped for lack of markets or financial backing. Performance specifications for such vehicles are in the literature, but the vehicles are often not available. Developments in vehicles suitable for Arctic transportation happen rapidly so it is difficult to keep current.

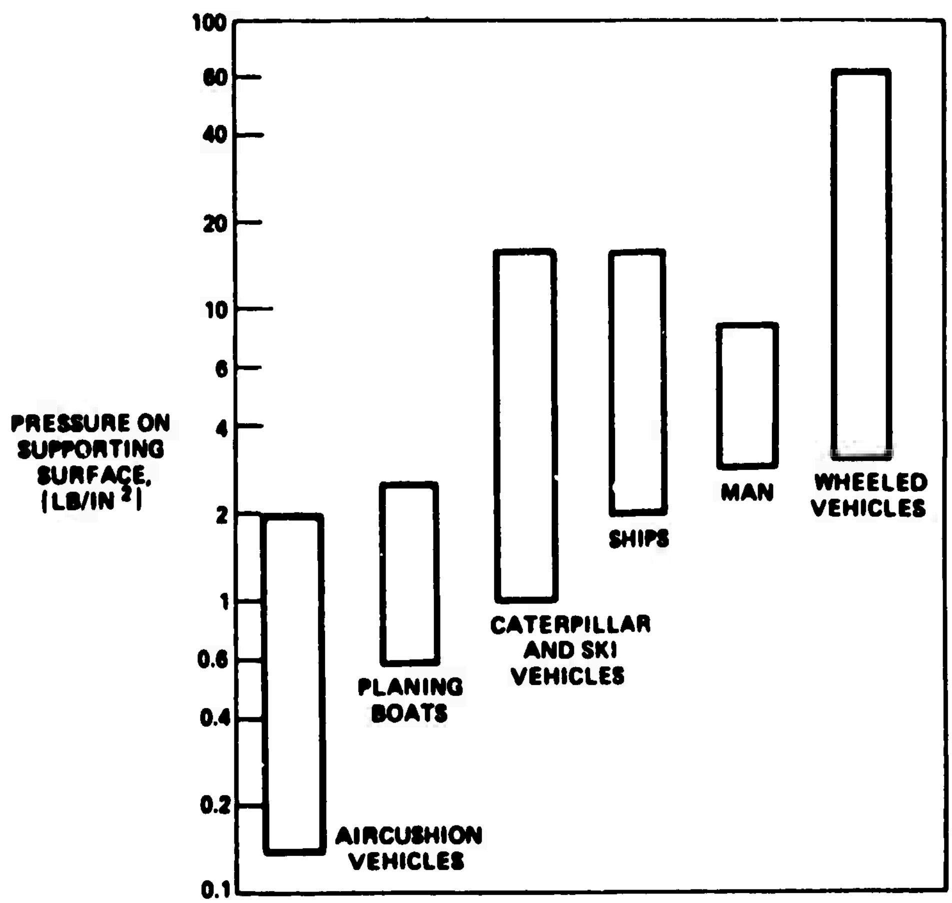
Land vehicles must be capable of traversing a variety of terrains and surface features. Pack ice, tundra, water and snow are the most common terrains in Arctic regions. Sub-Arctic Alaska includes all terrains above plus rocky or mountainous areas, glaciers, forests and every imaginable type of beach including mud.

Pack ice or sea ice is felt to be the most demanding terrain or feature that will be encountered during oil spill response. Leads and melt ponds impose a constraint in that water must be crossed. Several types of land vehicles are either amphibious or adaptable by adding flotation units. However, very few, if any, of the transport vehicles that have been operated in the Arctic are capable of climbing out of the water over a two-foot vertical edge.[2] Other aspects of the Arctic pack ice that relate to vehicle trafficability are numerous pressure ridges up to 5 or 6 feet, and the shear zone with its concomitant rubble and hummock fields, where the pack ice meets stationary shore-fast ice.[3] The shear zone which must be crossed to reach spills on pack ice nearly touches the shore at Barrow and is located up to several miles offshore in the remainder of the Beaufort Sea.

Traversing areas with deep soft snow, most commonly found in the sub-Arctic regions, incapacitates most types of vehicles suitable for travel over tundra due to high-centering. The U.S. Army Cold Regions Research and Engineering Laboratory facilities have extensive operational experience in the Arctic. Personnel in Fairbanks indicated that a suitable land vehicle does not exist for operation in all types of snow found in Alaska.[4] One of the worst land surface conditions that can be encountered is a fresh layer of snow over wet, unfrozen tundra. Under these conditions the vehicle will break through the snow cover, which has little or no bearing strength, and interact with the moisture-laden ground. The combination of snow, water, mud and organic matter can quickly halt even the best machine.[1]

Significant data has been produced on sinkage distribution under a track, sinkage rates, ground pressure under different soil and drawbar conditions, soil stresses at various depths,

and power dissipated in ground deformation by various track/roadwheel systems.[5] The concept of nominal ground pressure is virtually useless in evaluating data of this type because the nominal ground pressure is only an average of several widely varying peak loads. Peak loads can be reduced significantly by several design approaches such as articulating the vehicle and breaking long tracks into two or more track units. Figure 4-3 shows the ranges of nominal surface pressures exerted by various transport vehicles. Table 4-10 is a summary of land vehicles that have been used or are felt suitable for Arctic transportation. Further vehicle specifications appear in Appendix A.



Source: "Transportation in the Arctic" by F. C. Paddison, et al., prepared for the Naval Ordinance Systems Command. April 1972.

FIGURE 4-3 RANGE OF SURFACE PRESSURES EXERTED BY CONVENTIONAL TRANSPORTATION VEHICLES

TABLE 4-10

SUMMARY OF LAND TRANSPORTATION VEHICLES USED IN ARCTIC

Vehicle/Manufacturer	Type	Nominal Contact Pressure (psi) @NVW	@GVW	Approx. Drawbar Pull (lbs)	Net Weight (lbs)	Payload (lbs)	Approx. Personnel Capacity	Source/Ref.
Caterpillar D-7	T	7.1	---	---	26,400	---	< 4	Ref. 6
Caterpillar D-8	T	8.5	---	---	40,600	---	< 4	Ref. 6
Weasel M-29C	T	---	1.8	3,000	4,800	1,200	< 4	Ref. 6, 7, 8
Bombardier EDW	T	1.26	2.2	---	8,000	6,000	---	Ref. 6
Husky Eight	T	2.4	5.0	---	85,600	88,700	---	Ref. 6
Foremost Yukon	T	1.4	3.0	---	17,800	20,600	---	Ref. 6
Thiokol 1404	T	0.6	---	---	2,800	1,400	2	Ref. 6, Mfgr.
Volvo BV 202	T	1.2	---	---	6,406	2,000	---	Ref. 6
Flextrack Nodwell FN 400	T	1.9	3.4	---	54,000	40,000	3	Ref. 6, Mfgr.
Flextrack Nodwell FN 600	T	2.1	3.6	---	83,000	60,000	3	Ref. 6, Mfgr.
Flextrack Nodwell FN 45TT	W	3.0	--	---	10,000	4,500	2	Ref. 6, Mfgr.
Flextrack Nodwell FN 100TT	W	2.0	2.7	---	14,000	5,000	2	Ref. 6, Mfgr.
Flextrack Nodwell FN 600TT	W	---	5.2	---	75,000	60,000	2	Ref. 6, Mfgr.
SkiDoo Snowmobile - 1 track	HT	0.2	0.6	---	251	400	2	Ref. 6
SkiDoo Snowmobile - 2 track	HT	0.2	0.4	---	374	400	2	Ref. 6
Rolligon RD-** (Bechtel)	W	---	~4.0	---	26,000	20,000	---	Ref. 6
Musk Ox/WNRE	T	3.0	---	---	50,000	40,000	<10	Ref. 7, 8
Amphibious Cargo Carrier T-116	T	1.9	2.2	---	5,350	3,000	13	Ref. 7, 9
Caterpillar D-2 (LGP)	T	3.5	---	---	14,000	---	< 3	Ref. 7
John Deere 420 Crawler	T	2.5	---	---	4,700	---	< 3	Ref. 7
Polecat Mk II/WNRE	T	2.6	---	---	27,000	6,800	30	Ref. 7
Bombardier Snowmobile	HT	1.2	---	---	5,000	2,500	12	Ref. 7, Mfgr.
M-7 Half-track	HT	---	1.0	---	2,600	500	2	Ref. 7
Polecat/WNRE	AT	---	2.1	---	10,000	2,500	---	Ref. 7
Kristi Model KT-3	T	0.5	---	---	1,800	---	4	Ref. 7
Kristi Model KT-4	T	---	---	---	2,800	2,000	8	Ref. 7
WNRE Dinah	T	1.5	---	---	3,300	1,000	6	Ref. 7
Otaco Ltd Sled - 10 ton	---	---	5.6	---	9,000	20,000	-	Ref. 7
Otaco Ltd Sled - 20 ton	---	---	7.1	---	20,000	40,000	---	Ref. 7
Cushman Trackster	T	0.5	1.0	1,000	1,040	800	4	Ref. 2
Bombardier Muskeg Tractor	T	1.49	---	---	7,000	---	1	Mfgr.
Bombardier Muskeg Carrier	T	1.69	---	---	8,000	8,000	2	Mfgr.
Bombardier Muskeg Transporter	T	1.74	3.91	---	24,000	30,000	2	Mfgr.
Bombardier Skidozer 301	T	0.62	---	---	6,000	---	2	Mfgr.
Rolligon Model 6660	W	1.0	3.0	~5,000	10,500	12,000	< 3	Mfgr.
Rolligon Model 4450	W	1.0	1.5	~1,500	3,400	2,500	< 3	Mfgr.
Rolligon Model 8860	W	~1.0	~3.0	~7,000	15,500	~20,000	< 4	Mfgr.
Thiokol 1200 Series	T	0.7	1.0	---	6,550	1,900	10	Mfgr.
Sno T'rrain/Consolidated	T	1.6	---	75,000	---	---	7	Mfgr.
Tucker Sno-Cat 1500	T	0.84	---	---	5,800	1,650	6-8	Mfgr.
Tucker Sno-Cat 1600	T	0.68	---	---	6,000	1,800	6-8	Mfgr.
Tucker Sno-Cat 2700	T	0.55	---	---	7,800	7,300	6-8	Mfgr.

Abbreviations: GVW - Gross vehicle weight; NVW - Net vehicle weight; T - Tracked; HT - Half-tracked; W - Wheeled; AT - Articulated tracked; Mfgr. - manufacturer

4.3.2 Vessels

The present Coast Guard inventory of cutters in Alaska is felt adequate for logistic support capability in the areas of short and intermediate range response and field support. Surface Effect Ships (SES) would provide increased speed and thereby extend the effective response range of ships. The SES is described as a type of Surface Effect Vehicle in a subsequent section below.

Vessels smaller than cutters will be required for local transportation in offshore and nearshore spills in all areas. The types of fishing vessels available are described in Section 4.2.6. Small polar boats have been used in pack ice or shorefast ice that are fitted with sledge runners to facilitate hauling up inclines and dragging across the ice.(10) The arctic survey boats carried by Coast Guard icebreakers would provide excellent work boats for local transportation if available at or near the spill location. Inflatible boats with rigid bottoms powered by outboards similar to the French "Zodiak" are commonly used for lifeboats by fishing vessels. These versatile boats range up to approximately 16 feet and are well-suited to working in surf zones when the surf conditions are mild.

Hydrofoil vessels have the potential for rapid marine response. However, the use of hydrofoils in most Alaskan waters cannot be recommended because sea ice, potentially heavy seas, and shallow water would make operation potentially hazardous in unfamiliar waters.

4.3.3 Aircraft

Air transportation is the prevalent method of emergency response used in Alaska and will undoubtedly continue as such in the near future. The combination of fixed-wing and rotary-wing aircraft during rapid response is generally constrained

only by weather during operations state-wide. Coast Guard aircraft in Alaska (HC-130, HH-3F and periodically HH-52A) are near ideal for oil spill logistic support. The primary areas where aircraft capability is lacking are: (1) large transport helicopters such as the Army's CH-47 Chinook or CH-54 Skycrane; and (2) light STOL aircraft for personnel transfer and local transport.

Modification of the HC-130 or HH-3F aircraft that could extend the operational effectiveness of the aircraft include:

- Air-cushion landing gear (HC-130)
- Tricycle ski-wheel landing system
- Complete para-drop capability (HC-130)
- Modification to permit operation in extreme cold (up to -60°F)

Air-cushion landing gear (ACLG) has been developed for light aircraft such as the Twin Otter and Lake Amphibian.[8] The ACLG has further been proposed for heavy freighter aircraft such as the HC-130 and would make the aircraft either amphibious or equivalent in performance to STOL aircraft.

The U.S. Air Force has a restriction on C-130 aircraft operating from Barrow, Alaska at temperatures below -20°F.[11] Similar restrictions would be expected on Coast Guard HC-130 aircraft because of the similarity. Private industry has operated C-130 Hercules aircraft in temperatures colder than -20°F during airlift operations to the North Slope. It is assumed the same modifications could be made to Coast Guard HC-130 aircraft if they do not already exist.

Table 4-11 is a summary of selected aircraft with proven arctic operational capability.

TABLE 4-11

SUMMARY OF AIRCRAFT USED IN THE ARCTIC

Aircraft/Mfgr	Type	Approximate Payload (lb)	Runway Required (ft)	Approximate Range (mi)	Maximum Speed (kts)	Personnel Capacity	Reference/ Source
HC-130	FW	40,000	~4,000	2,500	320	~50	Coast Guard
HH-3F	RW	8,000	n/a	650	133	14	Coast Guard
HH-52A	RW	3,000	n/a	<300	109	<5	Coast Guard
C-124 (Globemaster)	FW	>50,000	>4,000	2,000	200	>50	Ref 7
C-121-J (Super Constellation)	FW	34,000	4,600	3,580	310	68	Ref 7
C-123-B	FW	16,000	1,800	1,900	130 (avg)	60	Ref 7, Ref 14
LC-47 Dakota:LC117	FW	6,000	-	1,400	227	6	Ref 7
C-47	FW	5,000	-	1,200	200	8	Ref 7
C-54 (Skymaster)	FW	-	-	3,000	-	-	Ref 7
CV-2B (Caribou)	FW	5,000	-	-	150 (avg)	-	Ref 7
U-1B (Otter)	FW	3,000	-	960	140	10	Ref 7
Cessna 180	FW	650	-	925	150	5	Ref 7
Cessna 185	FW	1,100	-	860	155	5	Ref 7
Cessna Super Sky Wagon	FW	1,800	-	830	151	5	Ref 7
Helio Courier MK-II	FW	1,510	STOL	1,288	142	5	Ref 7
de Havilland Beaver DHC-2	FW	1,500	STOL	468	140	6	Ref 7, Ref 2
de Havilland Beaver DHC-2, MK III	FW	1,780	STOL	(up to) 700	142	8	Ref 7, Ref 2
LH-34/Sikorsky	RW	2,500	n/a	320	122	9	Ref 7
UH-1B/Bell	RW	2,115	n/a	200	104	5-8	Ref 7
CH-19/Sikorsky	RW	2,250	n/a	310	101	6-9	Ref 7
UH-13/Bell	RW	500	n/a	165	75	1	Ref 7
de Havilland Buffalo	FW	12,000	STOL	-	250	-	Ref 2
S-64/Sikorsky	RW	20,000	n/a	25	-	-	Ref 2
205A/Bell	RW	5,000	n/a	300		13	Ref 2
CH-47C/Sikorsky	RW	20,000	n/a	350	110 (avg)	>20	Ref 8
Cessna R4D	FW	4,700	n/a	-	-	-	Ref 12
DC-6A or C-118A	FW	27,000	-	3,860	313	76	Ref 13
C-133A (Cargomaster)	FW	89,000	-	1,700	270 (avg)	0	Ref 14
U-10	FW	1,000	STOL	>1,000	176	4	Ref 14
FH-227O	FW	12,000	4,300	500	255	-	Ref 15

Abbreviations: FW = Fixed-wing
RW = Rotary-wing
n/a = Not applicable

4.3.4 Surface Effect Vehicles

Surface Effect Vehicles (SEV's) rank second only to helicopters in capability to traverse the terrain between any two points over short to intermediate ranges. Literature sources are virtually unanimous in opinion that SEV's have very significant potential for arctic transportation in the future. However, sources with the most arctic operational experience such as the Canadians generally feel that applications will be limited to suitable types of terrain and weather rather than Arcticwide. The experience gained in SEV operations in 61 countries points to a mobility not available in any other vehicle, but the same experience shows that SEV's at the current stage of development are not a replacement for other air, ground and water vehicles.[(2)(16)] A significant advantage of SEV's as compared to aircraft is the potential capability to operate in conditions of low visibility such as fog or low clouds.

Three types of SEV's have been developed in recent years:

- Fully air-supported amphibious craft
- Surface-penetrating marine craft
- Surface-contacting craft

Table 4-12 is a summary derived from commercial craft design features of these three types.[(17)]

Fully air-supported amphibious craft rely on a flexible skirt to contain the air cushion below the hard structure. The depth of the skirt is generally limited to one-sixth of the beam of the craft for stability reasons. Therefore, the general size of the craft determines the height of obstacles it will clear. An SEV can theoretically clear any obstacle that passes beneath the hard structure.

TABLE 4-12

DESIGN FEATURES OF ALL TYPES OF SEV'S

	Amphibious	Surface Penetrating	Surface Contacting
Cushion seal	Air curtain Peripheral Skirts Multi-cell Skirt	Rigid sidewalls and flexible curtains Peripheral Skirt	Peripheral Skirt Multi-cell Skirt
Propulsion	Air propellers Air jets	Water screws Water jets	Wheels Tracks Paddles
Yaw Control	Swivel propellers Air rudders Differential Propellers-Thrust Water Drag Rods	Water rudders Differential Propellers-Thrust	Steerable wheels Differential braking
Surface Ability	Any surface, obstacle height limited by skirt depth	Water only Water with partial beaching	Any surface, obstacle height restricted by structure clearance and skirt height

Surface-penetrating or sidewall SEV's are commonly called Surface Effect Ships (SES). The same term is also commonly used to describe very large air-supported craft. The sidewall SEV's normally have rigid extensions on the sides that penetrate the water surfaces and flexible skirts at the bow and stern. Propulsion is normally provided by propellers or water jets. The power required is less than that for fully air-supported craft, but speed and all-terrain capability are sacrificed. Surface-penetrating type SEV's do not appear to have potential for rapid response in Alaska due to lack of multiple terrain capability.

Surface-contacting craft are those types partially supported by an air cushion. Positioning, control and traction are provided by surface contact. Developments to date in surface-contacting craft have concentrated on relieving the load on conventional forms of land vehicles. Future applications are expected to focus on using ground contact to improve operational capability of craft with more of the inherent characteristics of the fully air-supported SEV's.

The effective speed of an SEV is directly related to skirt drag and the nature of the terrain. Drag is strongly dependent on surface material and to a lesser degree on surface roughness, vehicle speed and gap height.[18] Operational evaluations of the SK-5 in northern Michigan by the Cold Regions Research and Engineering Laboratory produced the following measurements of relative drag:[19]

• Grassy, dry surface	170 lb
• Marsh (live mat over water)	225
• Marsh with dense brush	460
• Marsh with thin brush	280

- Shallow water, below hump 945
- Deep water, below hump 545
- Deep water, above hump 425

Similar evaluation tests by the CRREL in Alaska showed the maximum speed attainable by the SK-5 over a frozen lake with snow covering was 83 mph as compared with a maximum speed of 55 mph over water.[18]

A summary of the potential deletarious effects on SEV operation due to the Alaskan environment or inherent SEV characteristics was excerpted from the references cited at the end of this section. The potential drawbacks include:

- Poor maneuverability
- Inability to climb or traverse slopes
- Will not operate effectively in trees
- Operations hampered by brush
- Greatly reduced combined man and machine efficiency at very low temperature
- Low temperature chill factor effects on skirt
- High maintenance
- Corrosion
- Severe icing and ice impact damage
- Uncomfortable or dangerous to ride over rough terrain
- Noise and vibration
- Sensitivity to winds (ride and turning)
- Requirement for greatly reduced speed when encountering obstacles or heavy seas

Elimination or alleviation of most of the drawbacks listed above is within the limits of current technology. However, the improvements will require several years.

Development of an Integrated-Mode SEV

Rapid advances have been made in SEV technology over the past decade. The areas of structural design, propulsion and lift requirements, communications, and flexible skirt have been studied intensely. Obstacle avoidance, for all-weather operation, is also under close scrutiny. These are general problems which will be solved through evolution in SEV development.

Based on the knowledge of the arctic environment, the mission requirement, and the problems in the dynamics of SEV operation, a motivation is provided for new designs integrating current SEV systems with the more classical ideas. Specifically, the weaknesses of an SEV lie in the areas of control and the ride qualities. Since an SEV operates in close proximity to the terrain and is influenced by wind forces and slopes, control and obstacle avoidance become critical. Operating characteristics such as turning radii, stopping distances, trim, yawing, etc. become dominating factors. Because an SEV operates on a cushion of air which may be in excess of 6 feet high, the ride quality is subject to dangerous oscillations. The vehicle is subjected to a spectrum of frequencies, amplitudes, and durations in heave, pitch, and yaw modes.

A new design in SEV's, well within the scope of existing technology, could circumvent some of the above difficulties. The design combines, in essence, two modes of transport, utilizing the best characteristics of each. It takes the basic SEV system and incorporates a system of suspended skis

and/or tracks to add to the stability, controllability, maneuverability, and ride comfort. The skis and/or tracks provide contact with the surface for maintaining direction, turning, and braking. The tracks could be considered for part of the propulsive power. Furthermore, contact with the ground surface provides for mechanical control of heaving and pitching. The air cushion would act as the primary suspension and the added suspension system would be necessarily, dynamically active. Thus, it could operate as a pure SEV, when necessary, or a pure ground vehicle in emergency situations. Under normal operating conditions, the tracks and/or skis would be activated by sensors to maintain a nominal surface loading pressure and a nominal driving force. For a vehicle with a 100 psf plenum chamber pressure, the contact surface pressure could be an additional 100 psf. Studies would have to be made to determine the optimal contact surface areas and pressures for a given SEV configuration.

Since the propulsion system is large on most SEV's, it could be used on the unsprung system to provide surges for positive control of the sprung (SEV structure) oscillations. Thus an active damping system can be used. This type of a system has been demonstrated to have very positive ride characteristics.

For maneuvering in wind or on severe slopes, the vectored propeller thrust, with a sensing-cueing system, would be synchronized with the force provided by the mechanical suspension to provide a single force vector in the direction of motion. The vehicle could be designed with anti-skid devices on the secondary suspension to provide maximum control of the vehicle. In an emergency, the secondary suspension will absorb the full effects of the vehicle, protecting the

flexible skirt from damage. The front skis would be designed to collapse when subjected to an unnavigable object.

Table 4-13 is a summary of SEV's that are either operational or under development.

TABLE 4-13

SUMMARY OF SURFACE EFFECT VEHICLE CHARACTERISTICS

Vehicle/Mfgr	Approx Length (ft)	Approx Width (ft)	Approx Range (mi)	Max Speed in Calm Water (kts)	Skirt or Clearance Height (ft)	Net Vehicle Weight (tons)	Cargo Capacity (tons)	Personnel Capacity	Reference/ Source
Denny D2	84	19	110	>30	2.3	24.0	8.2	>50	Ref 17
Hovermarine LTD HM.2	51	20	140	40	n/a	15.5	5.45	60	Ref 17
Mitsui MV-PP1	34	15	140	>50	0.3	2.9	0.75	-	Ref 17
SR.N4/BHC	130	77	175	70	5.75	113.5	~50	265	Ref 17
SR.N5/BHC	39	23	200	66	3.5	4.0	2.6	18	Ref 17
SR.N6/BHC	48	23	200	60	3.5	5.1	~3.0	38	Ref 17
Terraplane BC-7/Sedam	32	10	100	43(land)	n/a	2.75	2.4	-	Ref 17, 20
Sedam BC-8	33	17	60	62	2.7	2.6	2.5	1	Ref 17
Cushioncraft LTD CC-7	25	15	80	40	2.0	1.44	1.0	8	Ref 17, 21
Hovercat	27	13	60	37	2.0	1.8	.36	5	Ref 17
N.P.L. Hovercraft Unit HD.1	50	22	100	30	2.0	9.0	-	~5	Ref 17
N.P.L. Hovercraft Unit HD.2	31	19	100	45	2.0	4.4	-	~5	Ref 17
Mitsui MV-PP5	52	28	250	55	0.2	8.0	3.0	52	Ref 17
Sedam N-300	76	36	150	60	5.0	22.4	>5.0	90	Ref 17
SAAB 401W	24	10	-	39	0.3	2.0	.27	-	Ref 17
SK-5/Bell	39	24	360	70	3.5	5.8	~3.0	9	Ref 17, 21, 22
SR.N3/BHC	77	31	240	67	n/a	37.5	~10	-	Ref 17, 21
BH.7/BHC	77	41	140	65	n/a	32.4	8	72	Ref 17
Sedam N102	33	16	250	65	2.0	2.0	0.9	-	Ref 17
Vosper LTD VT1	96	45	450	48	5.5	56	23.4	>100	Ref 17
Sedam BC-7	40	20	200	-	n/a	-	10.0	-	Ref 17
Sedam BC-14	17	8	-	10	n/a	1.8	0.4	-	Ref 17
Hovermarine LTD HM-P1	107	39	170	40	n/a	44.3	>25.0	70	Ref 17
Hovermarine LTD HM-P2	137	27	170	40	0.5	69.8	36.0	-	Ref 17
Hovermarine LTD HM-P6	69	14	-	40(land)	n/a	10.0	10.0	-	Ref 17
Hovermarine LTD HM-P8	52	20	560	40	n/a	14.4	2.4	4	Ref 17
Hovermarine LTD HM.4	160	68	150	45	n/a	137	67	>100	Ref 17
BAC P-50 Modular System	58	36	-	48	4.0	26	24	-	Ref 17
Bell SK-6	49	24	190	56	3.5	5.7	6.0	33	Ref 17
Bell SK-9	56	33	210	61	-	23.5	8.8	90	Ref 17, 21
Bell SK-10	80	48	-	88	-	60.3	60	480	Ref 21
Enfield Marine EM.2	40	21	160	45	5.0	8.0	3.5	-	Ref 22
Enfield Marine EM.1	72	43	-	-	-	31.0	23	-	Ref 22
Bell Voyageur	65	34	7,400	50	4.0	16.8	20.25	-	Ref 22

BHC - British Hovercraft Corporation
n/a - Not applicable

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4.4 GENERAL AREA ACCESSIBILITY FACTORS

The logistics of oil spill response to the spectrum of potential spill locations within Alaska are far more complex than comparable response elsewhere within the United States. Present and projected Coast Guard Stations and Bases, with a capability for response makes the primary transportation aspects of oil spill response comparable to covering the entire conterminus 48 states from a single central location. The complexity of logistic operations are the result of many factors which influence response operations either individually or in combination. These influencing factors include:

- The immense geographic range both onshore and particularly at sea.
- The potentially hostile climatic and oceanographic conditions.
- Arctic conditions in the northern latitudes such as permafrost and lack of daylight in the winter.
- Lack of established facilities and transportation systems throughout most of the state which classifies most potential spill locations as being remote.
- The highly seasonal aspect of land and marine transportation.
- The rugged terrain along the southern coastlines combined with an almost complete lack of access by road networks.
- The requirement for more than one mode of transportation to reach many of the potential spill locations.

The logistics associated with oil spills in Alaska can be divided into three general response categories:

- Transport of men and/or equipment from a supply base to a suitable staging area at or near the scene of the spills (primary transportation).
- Transport of men and/or equipment from the staging area to the spill location and provision of local transportation thereafter (secondary transportation).
- Sustaining cleanup operations and providing personnel support functions over the entire period of time required to clean up the spill (field support).

A fourth category would obviously follow that entailed the return of men and equipment to the starting point. This category will not be included in the assessment of logistic support capability because it is not felt crucial to successful response.

Pre-Response Requirements

Rapid and effective response is dependent upon preplanning and preparedness. Procedures for notification of oil spills, designation of authority and the availability of support functions are specified in the Alaska Contingency Plan of the Coast Guard.(1) There are five response operations detailed within the plan:

- Phase I - Discovery and Notification
- Phase II - Containment and Countermeasure
- Phase III - Cleanup and Disposal
- Phase IV - Restoration
- Phase V - Recovery of Damages and Enforcement

The logistic response considered in this study begins somewhere between Phase I and Phase II for a large oil spill

with a request for assistance by the designated On-Scene Coordinator. The timing for the response efforts is assumed to begin at the time the request for assistance is received at the supply base. Precious time could conceivably be gained by instituting an oil spill alert procedure in Alaska. The alert would entail preliminary calling up of experienced personnel and readying of transport vehicles and equipment at the supply base immediately following notification of any potentially significant oil spill to the Coast Guard. A procedure for an oil spill alert is not specifically mentioned in the Alaska Contingency Plan. It might be assumed for most cases that preparations for logistic support would await a call for assistance from the On-Scene Coordinator after the OSC had arrived at the scene and surveyed the situation. This was the case during the oil spill in Cold Bay in March of 1973.[2] Awaiting the call for assistance could delay initiation of logistic response efforts up to several hours in typical spills in remote areas (which includes most of Alaska).

The guideline information provided by the Coast Guard for assessing transportation requirements are shown below in Table 4-14:

TABLE 4-14

TRANSPORTATION RESPONSE GUIDELINES

Environmental Description	Manpower Required	Time on Scene	Equipment Volume/Weight	Response Time
Moving Pack Ice	20	20 days	$\frac{1{,}000\ ft^3}{35{,}000\ lbs}$	1 day
Open Water	25	10 days	$\frac{1{,}000\ ft^3}{35{,}000\ lbs}$	10 hours
Shorefast Ice	15	15 days	$\frac{1{,}000\ ft^3}{35{,}000\ lbs}$	1 day
Tundra	15	15 days	$\frac{1{,}000\ ft^3}{35{,}000\ lbs}$	1 day

Personnel are generally transported to the scene of an oil spill much more readily than heavy equipment. Therefore, preparedness should be concentrated on having the necessary equipment ready to deploy. For most areas of Alaska, particularly onshore, large transportation vehicles will be at a premium or non-existent. Equipment must be prepackaged in the smallest practicable protected containers that are adaptable to all potential methods of handling and modes of conveyance. Methods of handling would include:

- Hoisting by crane or helicopter using slings
- Raising or lowering by forklift
- Dragging on sleds or skids
- Manhandling

Modes of conveyance for primary or secondary transportation would include:

- Flatbed trucks, pickups or off-road types of land vehicles (in the bed or cargo section)
- Fixed wing aircraft (normally inside)
- Helicopters (normally slung below)
- Ships or Surface Effect Vehicles (either on deck or in the hold)
- Sleds or skids (pulled by a land vehicle)

All equipment requiring protection from the environment or other types of protection such as isolation from shock or vibration must be prepackaged in shipping containers that afford the necessary protection regardless of the mode of conveyance. The shipping containers must further be safely handleable by all forms of handling tabulated above wherever possible. Proper identification and ready access for maintenance and/or inspection are also mandatory. The largest

container size desirable is one that will slip readily into the bed of a pickup (four ft by six or eight ft). The maximum desirable weight to permit manhandling is less than 200 lbs. Equipment prepackaged in small containers should be stored in larger cargo containers for primary transportation.

It is recognized that oil spill cleanup and containment equipment and some forms of field support equipment must exceed the limits of size and weight for manhandling. This larger equipment must be suitably prepackaged for handling by any of the other methods tabulated above. As a general rule for transportation within Alaska, the larger equipment should be broken down to the smallest practicable package size, even at the expense of additional assembly time in the field. There are simply too many potential instances where a large or heavy package might never reach its destination, especially in the Arctic. This general rule would contrast with procedures in the "Lower 48" states where mobile high-capacity cranes or similar gear are almost universally available. It is unlikely that a mobile crane will ever be available for oil spill logistic response in Alaska. In no case should a single package exceed the size or weight that can be unloaded from an HC-130 aircraft at a remote airfield, (approximately 8 ft x 5 ft x 20 ft/15,000 lbs).

Most of the 15 to 25 personnel required for oil spill cleanup operations could presumably be enlisted from any Coast Guard facility or combination of facilities within the state. However, personnel trained in oil spill cleanup procedures would necessarily comprise a portion of the personnel to be transported to the spill location. Trained personnel are presently available from the Task Force maintained at the COPT Anchorage and the Pacific Strike Team in San Francisco. The personnel aspect of response logistics would be greatly simplified if the required manpower was consolidated in one location.

The best single location would be at the supply base because the personnel could be used to prepare and load equipment. Some of the personnel could also be transported by the vehicles carrying primarily equipment. The analysis of response time in subsequent sections of this study assumes that all personnel are available, and originate from the same location as the equipment (either Kodiak or Anchorage). Kodiak is the only large potential source of Coast Guard personnel at present located near the mainland of Alaska.

A facet of personnel preparedness that is covered elsewhere within the study, but bears repeating, is the requirement that all personnel arrive at the staging area in a condition to sustain themselves for an extended period (up to 72 hrs). No person should arrive at the scene without a complete set of survival gear.

Primary Transportation

Primary transportation of men and/or equipment from a central supply base to the scene of spill is possible by any one or a combination of the following modes of conveyance:

Aircraft

- Fixed-Wing
- Helicopters

Vessels

- Cutters
- Surface Effect vehicles
- Smaller ships or barges

Land Vehicles

- Commercial trucks (including four-wheel drive)
- All Terrain Vehicles or off-road vehicles

Modes of conveyance are classically categorized into one of three types of transportation: air, marine, or land. SEV's

and some of the ATV's would normally be capable of either marine or land transport. However, the possibility of very hostile oceanographic conditions between the supply bases considered and the potential spill locations would minimize the possibility of SEV's and ATV's serving in a dual mode for primary transportation. The dual mode might be possible for secondary transportation at the spill site.

All three forms of transportation (i.e., air, marine or land) have relative advantages and disadvantages for primary transport of men and/or equipment to selected spill sites. The greatest constraint to effective response in Alaska is distance. Environmental conditions such as seasonal ice in marine areas and the lack of road systems within Alaska also cause severe constraints on certain types of transportation. Table 4-15 indicates the approximate distances from Kodiak and Anchorage (assumed to be supply bases) to major population areas and the representative oil spill sites selected for evaluation in Section 5.0.

Transport by land vehicles normally is the most dependable method because of less sensitivity to hostile environmental conditions and minimal requirements for communications or navigational aids. Unfortunately, the interconnected road network within Alaska is very limited, being practically nonexistent in the Arctic. Existing roads are essentially limited to the south-central portion of the mainland between Anchorage, Fairbanks, and the Canadian boundary. The Trans-Alaska Pipeline access road was recently completed but offers only a single north-south corridor through a land area more than 500 miles wide. Response by land vehicles is severely constrained by increasing distance.

Marine transportation is attractive to the Coast Guard because available ships are normally dispersed widely throughout Alaska. Cutters are relatively insensitive to severe

TABLE 4-15

APPROXIMATE DISTANCES BETWEEN MAJOR LOCATIONS IN ALASKA ASSOCIATED WITH OIL SPILL RESPONSE BY VARIOUS TYPES OF TRANSPORTATION (NAUTICAL MILES)

	Anchorage		Kodiak	
	Air	Road	Air	Sea
Anchorage	-	-	300	325
Kodiak	300	-	-	-
Fairbanks	300	380	575	-
Juneau	675	-	725	750
Sitka	675	-	725	725
Barrow	850	-	1,100	2,200
Cordova	175	-	350	375
Homer	150	200	150	175
Yakutat	425	-	550	550
Valdez	150	260	350	375
Port Graham	175	-	125	150
Drift River Terminal	100	-	225	250
Unimak Pass	850	-	650	700
Port Moller	625	-	375	950
Kvichak Bay	350	-	200	1,200
Nome	650	-	725	1,500
Kotzebue	650	-	800	1,800
Prudhoe Bay	750	850	1,000	2,400
Unimat	650	-	900	-
Yukon River Crossing of TAPS	375	500	650	-
Denali Fault Crossing of TAPS	225	300	525	-

Note: The distance between Anchorage and most sites outside Cook Inlet by sea can be roughly obtained by adding 300 to the distance from Kodiak.

climatic and marine conditions and make an ideal working platform for combating marine oil spills. However, the potentially large distances between the supply bases and possible spill locations and presence of sea ice during the winter in the Bering Sea and Arctic Ocean severely limits the potential for use of cutters as a means of primary transportation. If even the most optimistic conditions are assumed concerning cutter availability (High Endurance Cutters available to steam for 20 hours at 29 knots), a minimum of four supply bases would be required to blanket the marine waters of Alaska. Area access by large cutters is further restricted by the shallow waters existing along the Bering Sea and Arctic coastline.

Air transportation is the least dependable of the three possible methods because of sensitivity to climatic conditions and need for ancillary communications and navigation gear. Aircraft response is least affected by long distances because transit speed is approximately one order of magnitude greater than ships or land vehicles. Helicopters lack both range and payload capacity, so the bulk of primary transportation response will have to be accomplished with large fixed wing aircraft such as the HC-130. Helicopters would be useful for the primary transport of personnel. The HC-130 requires a runway approximately 4,200 ft long (unimproved) which simply do not exist near all potential oil spill locations. Thus, either a second mode of conveyance or air-drop capability will be required to complete primary transportation response from the supply base to a staging area when HC-130's are used for transportation.

An effective method of primary transportation response to spills in the waters of the Gulf of Alaska and southern Bering Sea may be to transport the man and/or equipment by aircraft to an intermediate location where adequate docks and runways both exist and transship by cutter or other vehicle to the spill location. Suitable transshipment sites would include

Yakutat, Cordova, Valdez, Homer, Anchorage, Cold Bay, Dutch Harbor and King Salmon.

Surface Effect Vehicles are not considered operational primary transportation response at the present stage of development for the following reasons:

- Inability to cross expanses of open ocean under all conditions existing in Alaska
- Limited speed when enroute obstacles are encountered and lack of range
- Lack of reliability

Secondary Transportation

Most secondary conveyance vehicles will either have to be available at or near the oil spill site or be air transportable. Helicopters such as the amphibious HH-3F are the most versatile means of conveyance available for light logistic support at present. However, ferrying helicopters over great distances to the spill site under conditions such as winter in the Arctic or foul weather can be problematic. ATV's and SEV's are generally limited in range and not readily air-transportable.

Coast Guard cutters or private vessels available at the scene within a few hours of the call for assistance could provide the necessary secondary transportation and serve as a working platform for marine spills. Cutters carrying helicopters would provide a near ideal secondary transportation and field support combination. The launches carried by cutters would also be useful for light transportation in shallow waters.

The requirements for secondary transportation in arctic regions and onshore areas cannot presently be met by Coast

Guard systems in Alaska. Development of adequate secondary transportation support systems or enlistment of available systems of other agencies is clearly indicated. The local availability of adequate secondary logistic support systems is, at best, seasonal in most areas of the Arctic and many regions of the Sub-arctic. The HH-3F helicopter is the only means of conveyance operated by the Coast Guard in Alaska with a capability to transport men and equipment to and from either moving pack ice or shorefast ice. The logistics involved in moving these aircraft rapidly to locations north of the Arctic Circle from the air stations (Kodiak or Sitka) are considered far too complex for consideration as a current operational capability.

4.4.1 Considerations for Supply Bases and Staging Areas

The proper selection of a supply base and cataloging of potential staging areas throughout the state are the most important elements of preparedness for logistic response to oil spills. The next most important element of preparedness is proper packaging of equipment and supplies for transport by the various modes of primary conveyance available. The supply base (or logistic center) would ideally be located at a hub for all three types of transportation (i.e., marine, air and land). The supply base should further be located on or very near a Coast Guard Base or Station. All of the equipment for oil spill containment and cleanup and all equipment and supplies to sustain field efforts for extended periods should be available for deployment on short notice (one or two hours). The field support equipment and supplies available must be adequate to sustain all field operations and communications for a very minimum of 72 hours.

Anchorage is the only city within Alaska that even remotely qualifies as a center for all types of transportation. It is definitely the hub of all commercial, civilian and military air transportation. However, marine transportation is seasonal, being practically non-existent during severe winters due to heavy sea ice formation in Upper Cook Inlet. Anchorage is also a center of land transportation because of central location on the interconnected road system. The Alaska Railroad also passes through Anchorage.

Fairbanks is second to Anchorage as a hub of air transportation and commonly used as a jumpoff point for Arctic travel. Marine transportation does not exist in Fairbanks that would be of avail to oil spill response. Fairbanks is on the interconnected road system of the state and will serve as the center of transportation for the Trans-Alaska Pipeline construction activity over the coming years. The northern terminus of the Alaska Railroad is located in Fairbanks.

Kodiak is a center of marine transportation for the central Gulf of Alaska and is increasing in that respect if the fishing industry is included. Kodiak is not an air transportation center; the island location precludes road transportation.

<u>Supply Bases</u>

The supply base or central logistic center would ideally be located at a transportation hub near the geographic center of the oil spill response area to minimize the average travel time to the outlying regions. The scope of Alaska defies the simple choice of a single best location when this and all other logistic factors are considered. Fairbanks qualifies as the best choice from a purely geographic standpoint. The

following summary includes the characteristics felt most important to the selection of a supply base or logistics center.

- Central location geographically
- Location at or near a Coast Guard Base or Station where adequate personnel are available
- Immediate proximity to an all-weather major airport
- All types of transportation available (i.e., air, marine and land)
- Location at or near an ice-free port
- Suitable indoor storage facilities
- Equipment available for rapid loading of all available modes of conveyance
- Personnel support facilities nearby
- Replacement supplies and field support services available nearby

There is no location within Alaska that meets all of the above desired characteristics. Anchorage is felt to come the closest, followed by Fairbanks or Kodiak. The major supply base could conceivably be located outside of Alaska in the future, either in the Northwest or San Francisco as is essentially the case at present. However, the great distances involved and restrictions in travel described earlier are felt to make response from supply bases outside the state ineffective.

The probable differences in equipment and supplies required for oil spill response in the Arctic and to onshore spills as compared to sub-arctic marine spills suggests that

two major supply bases located within Alaska would enable more effective response and make better use of projected Coast Guard presence. The base for sub-arctic marine spills would be at a major marine transportation center such as Kodiak. The primary base for Arctic spills both onshore and offshore would be at a northern air transportation center such as Fairbanks.

Staging Areas

The characteristics desired for a staging area vary considerably with the type or geographic location of the spill. Staging areas must obviously provide an adequate terminus for the primary transportation function. Staging areas for oil spills on both open water and shorefast or pack ice will most likely be located on shore near the spill location. These staging areas can be either temporary or permanently established for the duration of oil spill response efforts. More than one staging area might be necessary in the Arctic or in cases of marine spills in which the oil slick is moving.

Response to most oil spills in the Arctic may require the establishment of a temporary staging area at an airfield or landing strip capable of accomodating larger aircraft such as the HC-130. At this point the distinction between a staging area and an extension of the primary transportation system becomes moot. The distinction used in the evaluations in Section 5.0 limits the definition of a staging area to locations from which continuing secondary transportation and resupply functions are conducted throughout the duration of the spill. A staging area in a broader sense includes any site at which personnel are fed and quartered or from which equipment is deployed to the oil spill. A large vessel could serve as a staging area at some locations.

The following is a summary of desired characteristics for staging areas that were derived mainly from interviews with military and civilian personnel familiar with Arctic field operations:

- Location on safe, permanent terrain (onshore in the Arctic)
- Location that has ready access to a town or village having supplies, transportation, and emergency services available
- Near proximity to a suitable airport or landing strip (over 4,000 feet long)
- Access to local road system (if present)
- Location on high ground with no rivers between staging area and spill site (summer)
- Location near permanent shelters for personnel and equipment, (if not, suitable terrain and protection from prevailing hostile weather)
- Protected waters with docking facilities available
- Availability of mechanical cargo handling equipment
- Proximity to commercial air transportation and communication facilities

Personnel at the Naval Arctic Research Laboratory(3) and U.S. Army Cold Regions Research and Engineering Laboratory in Fairbanks(4) advised against the initial establishment of staging areas on any type of sea ice during emergency or rapid oil spill response operations. Many field stations have been successfully set up on pack ice and ice islands over the years. However, all required considerable preplanning, prior site surveys, and a certain element of luck.

Camps have been split down the middle by leads opening in the ice. Leads in the ice that have frozen over make excellent runways for aircraft as large as HC-130's. However, a lighter aircraft or helicopter are first required to land and sample the ice thickness by coring. Approximately 40 inches of ice thickness are required to support an HC-130. Coast Guard icebreakers are the best available staging platforms on the ice. However, the availability of icebreakers would be a matter of opportunity as the response time would normally be too long.

4.4.2 Locations of Coast Guard Bases and Stations

Present and projected Coast Guard facilities within Alaska will undoubtedly be the first considered for supply bases, staging areas, and sources of personnel and equipment for field operations. The presence of the Coast Guard is generally strongest in Southeast Alaska and the coastal areas of the Gulf of Alaska. A very limited number of personnel are permanently stationed in the Arctic (actually, anywhere north of Anchorage). Table 4-16 is a summary of existing facilities.

The Coast Guard Air Stations at Kodiak and Annette Island provide aircraft logistic support frequently to the following stations throughout Alaska:[5]

- Cape Sarichef (Kodiak)
- Cape Decision (Annette)
- Cape Spencer/Five Finger (Annette)
- Cape St. Elias/Cape Hinchinbrook (Kodiak)
- Port Clarence (Kodiak)
- Yakutat (Kodiak)
- St. Paul (Kodiak)
- Attu (Kodiak)
- Sitkinak (Kodiak)

TABLE 4-16

CURRENT AND PROJECTED
COAST GUARD FACILITIES IN ALASKA

Function	Location(s)	Comments
Headquarters	Juneau	
Air Stations	Kodiak	
	Annette Island	Phasing out
	Sitka	Operational in 1976
Bases	Kodiak	
	Ketchikan	
Cutter Home Ports	Adak	
	Ketchikan	
	Juneau	
	Petersburg	
	Seward	
	Kodiak	
	Sitka	
	Homer	
	Cordova	
Captain of the Port and Marine Inspection Offices	Anchorage	
	Juneau	
	Ketchikan	
Manned Light Stations	Cape Decision	
	Cape Hinchinbrook	
	Cape St. Elias	
	Cape Spencer	
	Five Finger	
Loran Stations	Adak	Type A
	Attu	Type A and C
	Biorka	Type A
	Cape Sarichef	Type A
	Ocean Cape	Type A
	Port Clarence	Type C
	St. Paul	Type C
	Sitkinak	Type C
	Spruce Cape	Type A
Communications and Radio Stations	Kodiak	Communications Station
	Ketchikan	Radio Station
	Barrow	Radio Station
	Adak	Radio Station

4.4.3 Locations of Military Bases and Stations

A unified Alaska Command (ALCOM) office coordinates many inter-service activities under the Commander-in-Chief, Alaska, (CINCAL). Component commands under CINCAL include the United States Army Alaska (USARAL), Alaskan Air Command (ALCOM), Commander-in-Chief, U.S. Pacific Fleet (CINCPAC) Liason, and Alaska NORAD/CONRAD. Table 4-17 is a summary of Alaskan Command facilities as of 1970.[6]

4.4.4 Locations of Other Federal and State Installations

Federal and State installations are widespread throughout Alaska, particularly south of the Brooks Range. Table 4-18 is a summary of selected installations that might prove useful for oil spill response support, primarily as staging areas or to provide services. Airports are tabulated in a subsequent subsection.

TABLE 4-17

ALASKAN COMMAND FACILITIES

Major Alaskan Command Military Installations

Location	Installation	Activities
Adak Island	Naval Station	NAVCOMMSTA Adak
Anchorage	Elmendorf AFB	Hq ALCOM
		Hq AAC
		Hq ANR
		Hq ACR
		DCA Alaskan Area
		602 Military Airlift Support Sq (MAC)
		Hq 6981 Security Group (USAFSS)
		Interceptor and Troop Carrier Acft
	Fort Richardson	Hq USARAL
		USARAL Spt Cmd
		Hq Fort Richardson
		172 Infantry Brigade
		Hq 87th Artillery Group (AD)
		69th General Support Group
		19th Aviation Battalion
		USASTRATCOM Signal Group (Alaska)
		Combat Developments Agency
		U.S. Army District Engineers
Big Delta	Fort Greely	Hq Fort Greely
		Arctic Test Center
		U.S. Army Northern Warfare Training Center
Fairbanks	Fort Wainwright	Hq Fort Wainwright
		808th Engineer Battalion (CONST)
		171 Infantry Brigade
		Northern Terminal Pipeline
		Arctic Aeromedical Laboratory
		Alaska Field Station Terrestrial Sciences Center
	Eielson AFB	SAC Reflex Force
		Fighter Acft
	Murphy Dome	ANR-ALCOP
Galena	Galena Airport	Deployment, AD Squadron
Haines	Haines Port	Southern Terminal Haines/Fairbanks Pipeline
Juneau	Juneau	Hq 17th Coast Guard Dist
Kenai	Wildwood AFS	Communications Facilities
Kodiak Island	Naval Station Kodiak	Hq ALSEAFRON
		NAVCOMMSTA Kodiak
King Salmon	King Salmon Airport	Deployment, AD Squadron
Point Barrow	Point Barrow	Naval Petroleum Reserve
		Arctic Research Laboratory
Shemya Island	Shemya AFB	Army-Air Force Joint Operation Group
		Det 1, 6th Strat Wg
		16th Surveillance Sq (ADC)
		USASA Field Station

Oil Pipeline and Storage Facilities

Location	Installation	Activities
Adak	Naval Station Adak	POL Terminal and Port
Anchorage	Port Facility	Terminal Whittier/Anchorage Pipeline and Port
Beaver Creek, Y.T.		POL Pumping Station
Big Delta	Fort Greely	POL Terminal
Birch Lake		POL Terminal
Blanchard River, Y.T.		POL Pumping Station
Border, B.C.		POL Pumping Station

Table 4-17 contd 1.

Location	Installation	Activities
Destruction Bay, Y.T.		POL Pumping Station
Donjek, Y.T.		POL Pumping Station
Dutch Harbor		POL Terminal and Port
Fairbanks Area	Fort Wainwright	Northern Haines/Fairbanks Pipeline Terminal
	Eielson AFB	POL Terminal
Haines	Port Facility	Southern Haines/Fairbanks Pipeline Terminal and Port
Haines Junction, Y.T.		POL Pumping Station
Kodiak	Naval Station Kodiak	POL Terminal and Port
Lakeview		POL Pumping Station
Sears Creek		POL Pumping Station
Timber		POL Facilities
Tok Junction		POL Pipeline Terminal
Whittier		POL Terminal for Whittier/Anchorage Pipeline and Port
		Alaska National Guard
Anchorage Area		Office of the Adjutant General
		Hq Alaska Air National Guard
		Hq Alaska Army National Guard
	Camp Thomas P. Carroll	Alaska Army National Guard Annual Field Training Site
	Kulis ANG Base	176th TAC Airlift Group, Alaska ANG
	CSMS-AFTEP	Support Maintenance and Annual Field Training Equipment Pool
	USPFO	United States Property and Fiscal Office
	Armory	Hq 3d Bn (Mech), 297th Inf
		HHD, Alaska ARNG
Bethel	Armory	Hq 2d Scout Bn, 297th Inf, Alaska ARNG
Fairbanks	Armory	216th Transportation Co, Alaska ARNG
Juneau	Armory	910th Engineer Co, Alaska ARNG
Kenai	Armory	Alaska ARNG Unit, 2d Rifle Platoon Co B, 3d Bn, 297th Inf
Ketchikan	Armory	Co A, 3d Bn (Mech), 297th Inf, Alaska ARNG
Kodiak	Armory	Alaska ARNG Unit, Weapons Platoon, Co A, 3d Bn, 297th Inf
Nome	Armory	Hq 1st Scout Bn, 297th Inf, Alaska ARNG
Seward	Armory	Alaska ARNG Unit, Weapons Platoon, Co B, 3d Bn, 297th Inf
Sitka	Armory	Alaska ARNG Unit, 2d Rifle Platoon, Co A, 3d Bn, 297th Inf

Note: In addition, there are small Eskimo Scout units and armories in 62 additional communities throughout the northern and western part of the State.

Principal Ports Used for Military Cargo

Adak	Kodiak	Whittier
Anchorage	Seward	
Haines	Valdez	

Aircraft Control and Warning Sites

Installation	Sq	Remarks
Campion	743	NCC
Cape Lisburne	711	NSS
Cape Newenham	794	NSS
Cape Romanzof	795	NSS
Cold Bay	714	NSS
Fort Yukon	709	NGCI
Indian Mountain	708	NGCI
King Salmon	705	NCC
Kotzebue	748	NGCI
Murphy Dome	744	NCC

Table 4-17 contd 2.

Installation	Sq	Remarks
Sparrevohn	719	NGCI
Tatalina	712	NGCI
Tin City	710	NSS

DEW Line Sites

Location	Remarks
Barter Island	DEW Line Main Data Center
Flaxman Island	DEW Auxiliary Site
Lonely	DEW Auxiliary Site
Oliktok	DEW Auxiliary Site
Point Barrow	DEW Line Main Data Center
Point Lay	DEW Auxiliary Site
Wainwright	DEW Auxiliary Site

NIKE Sites

Installation	Remarks
Point	Anchorage Area
Bay	Anchorage Area
Summit	Anchorage Area
Peter	Eielson Area
Tare	Eielson Area
Love	Fairbanks Area

WHITE ALICE Stations

Adak	Cape Sarichef	Indian Mountain	Pillar Mountain
Aniak	Clear	Kalakaket Creek	Shemya
Anvil Mountain	Cold Bay	King Salmon	Smuggler Cove
Bear Creek	Delta Junction	Kotzebue	Soldotna
Bethel	Diamond Ridge	Murphy Dome	Sparrevohn
Big Mountain	Duncan Canal	Neklason Lake	Tatalina
Boswell Bay	Fort Yukon	Northeast Cape	Tin City
Campion	Galena	North River	Tok Junction
Cape Lisburne	Glennallen	Ocean Cape	Unalakleet
Cape Newenham	Granite Mountain	Pedro Dome	Yakataga
Cape Romanzof	Hoonah		

Communications Facilities

Location	Installation and/or Facilities
Adak	Naval Communications Station
Anchorage Area	Elmendorf AFB
	Fort Richardson
	Anchorage ACS
	ACS Toll Building
	Federal Aviation Agency
Aurora	Communications Facilities
Beaver Creek	Communications Facilities
Black Rapids	Communications Facilities
Boswell Bay	Communications Facilities
Canyon Creek	Communications Facilities
Cathedral	Communications Facilities
Clear	Communications Facilities
Cold Bay	Communications Facilities
Delta Junction	Communications Facilities
Donnelly	Communications Facilities
Duncan Canal	Communications Facilities
Fairbanks Area	Eielson AFB
	Fairbanks ACS
	Fort Wainwright
	Murphy Dome
Gerstle	Communications Facilities

Table 4-17 contd 3.

Location	Installation and/or Facilities
Glennallen	Communications Facilities
Gold King Creek	Communications Facilities
Harding Lake	Communications Facilities
Hoonah	Communications Facilities
Kenai	Wildwood Receiver Station
Ketchikan	Shore Ends of Submarine Cable
Kodiak	Naval Communications Station
	Holiday Beach Receiver Site
Knob Ridge	Communications Facilities
McCallum	Communications Facilities
Murphy Dome	Communications Facilities
Neklason Lake	Communications Facilities
Nome	Communications Facilities
Ocean Cape	Communications Facilities
Paxson	Communications Facilities
Pedro Dome	Communications Facilities
Point Barrow	Communications Facilities
Sawmill	Communications Facilities
Sheep Mountain	Communications Facilities
Sitka	Communications Facilities
Skagway	Shore Ends of Submarine Cable
Smugglers Cove	Communications Facilities
Tahneta	Communications Facilities
Tok Junction	Communications Facilities
Tolsona	Communications Facilities
Yakataga	Communications Facilities

Note: Kodiak Naval Station was phased out in the early 1970's.

TABLE 4-18

SELECTED FEDERAL AND STATE FACILITIES WITHIN ALASKA[6]

Facility	Location	Agency	Description/Comments
Hospitals	Adak	U.S. Navy	26 beds
	Anchorage		Several federal, state & private
	Barrow	USPHS	14 beds
	Bethel	USPHS	55 beds
	Big Delta	U.S. Army	Fort Greely Dispensary
	Cordova		22 beds
	Fairbanks		Several federal, state & private
	Glenallen		2 beds
	Homer		6 beds
	Juneau		67 beds
	Dillingham	USPHS	44 beds
	Ketchikan		97 beds
	Kodiak		20 beds
	Kotzebue	USPHS	54 beds
	Nome		29 beds
	Palmer		25 beds
	Petersburg		21 beds
	St. George Island	USPHS	6 beds
	St. Paul Island	USPHS	7 beds
	Seward		33 beds
	Sitka	USPHS	130 beds
	Soldotna		30 beds
	Tanana	USPHS	32 beds
	Valdez		165 beds
	Wrangell		12 beds
	Skagway		5 beds
State Parks	Chugach (SW of Anchorage)	State of Alaska	500,000 acres
	Kachemak Bay (south side of Bay)	State of Alaska	135,000 acres
	Denali (south of McKinley Park)	State of Alaska	280,000 acres
National Parks & Nat. Monuments	Mt. McKinley Park	USFS	
	Glacier Bay National Monument	USFS	
	Katmai National Monument	USFS	
Wildlife Refuges & Ranges	Chamisso NWR	Fish & Wildlife Service	
	Arctic NWR		
	Bering Sea NWR		
	Nunivak Island		
	Hogen Bay NWR		
	Rhode NWR		Hdqtrs at Bethel
	Izenbek NWR		Hdqtrs at Cold Bay
	Tuxedni NWR		
	Kenai Moose Range		Hdqtrs at Kenai
	Semidi NWR		
	Kodiak Bear Range		Hdqtrs at Kodiak
	Forrester Island NWR		
	Simeonof NWR		
	Aleutian Island NWR		
	Bogoslof NWR		
	Pribilof Islands		
National Forests	Chugach	USFS	Hdqtrs Cordova & Seward
	Tongass		

Note: There are additional major withdrawals of land throughout the state by the Bureau of Indian Affairs and Bureau of Land Management.

4.4.5 Environmental Factors

Six aspects of the northern climate generally characterize the physical environment of Alaska. The first is the distinctive regime of daylight and darkness which, together with low solar elevation, gives rise to a prolonged period of darkness and radiational heat loss from the earth's surface.

The second is the surface cover of snow or ice producing a high albedo for at least a significant part of the year. In cold regions the high albedo of the surface depends largely on whether there is a snow or ice cover. The immediate effect of changes in this cover on the heat exchange at the surface is so great that the Arctic region of Alaska can be said to have two seasons only, with a swift transition of a week or two each at the spring thaw and the fall freeze-up. However, toward mid-latitudes in the periglacial zone, as the length of the snow-free period increases variations from winter to winter in the timing and continuity of the snow cover become more important and the number of freeze-thaw cycles in the year increases accordingly.

The presence of a snow or ice cover plays an important role in the modification of air masses crossing the region. Extra-tropical cyclones depend on temperature contrast and, generally speaking, their intensity and frequency are closely allied to the sharp gradients at the margins of the snow or ice cover and open water. Low clouds and fog, characteristic of coastal areas, and the broken pack ice in summer are essentially linked with the distribution of snow or ice and open water.

The third aspect is the presence of the Alaska, Bering Sea, and Arctic ocean currents. The maritime influence on temperature and precipitation is present along the whole coast of Alaska and even exerts a modifying influence on the North Slope and other coastal regions during the winter season.

The fourth aspect is the effect on surface weather systems of the large-scale, cold-cored circumpolar vortex present in the free atmosphere. The surface cyclones and anticyclones responsible for much of the day-to-day weather are embedded in and steered by this flow, so that changes in the shape and position of the vortex radically affect day-to-day weather conditions.

Fifth, the land topography, including glaciers, produces wide variations in climate and local weather within relatively short distances. Topographic features such as the Brooks, Alaska, Aleutian and Coastal ranges have profound effects on temperature, precipitation, and winds.

The sixth distinctive aspect of the climate is the presence of pronounced temperature inversion above the snow, ice or ground surface resulting from strong radiational cooling. Inherently a stable feature under conditions of negative radiation balance at the surface in winter, it is only temporarily or partially cleared by strong winds, cloud cover, or precipitation associated with cyclonic activity, after which it rapidly reforms. The configuration of the surface plays an important role in the local intensity and persistence of the inversion; e.g., the shallow Yukon Valley tends to trap the dense cold air, resulting in high frequencies of inversions.

Regional Climate

Alaska has been divided into four climatic zones: a) Maritime, b) Transitional, c) Continental, and d) Arctic.[7] For convenience in this study we will consider the following five regions which follow the climatic zones very closely.

The Gulf Coast

This region includes the southeast coast and northward to Cook Inlet and Kodiak Island. The climate is generally maritime, with the more northern areas approaching a transitional climate.

This portion of Alaska is covered by very rugged terrain and glaciers which have a pronounced effect on the local weather, particularly winds and precipitation. Local drainage winds associated with low-pressure storm systems cause wind speeds in excess of 60-70 mph (52-61 knots). The passage of numerous cyclonic storms results in frequent precipitation throughout the year. However, precipitation amounts are quite variable, depending on the topography near the observation station. Thunderstorms are rare. The occurrence of fog increases from winter to summer.

Alaska Peninsula and Aleutian Islands

The climate of this region, like the eastern part of the Gulf of Alaska, is maritime. The high frequency of cyclonic storms crossing the Aleutian Island chain is the dominant factor in the weather. These storms account for the high winds, frequent occurrence of low cloud ceilings, frequent precipitation and low visibility.

The Bering Sea Coast

Bristol Bay, Yukon-Kuskokwim Delta, Norton Sound and Kotzebue Sound have transitional-type climates which are characterized by mean annual temperatures of 25-35°F (-3.9 to +1.7°C), annual precipitation of 7 to 30 in., and occasional strong winds along the coastal areas.

The coastal areas are more maritime than continental, which tends to modify daily temperature extremes during most of the year. Continental climatic influences are noticeable during mid-summer and again during mid-winter.

Precipitation and cloudiness are maximum during the ice free months of July, August, and September. Storms in the Bering Sea often cause wind speeds to exceed 50 mph (43 knots). Such high winds cause local flooding along the low-lying coastal areas.

The Arctic Coast or North Slope

The "North Slope," particularly the coastal region, is classified as Arctic maritime. The general climatic conditions are characterized by cold temperatures (mean annual 10°-20°F), small annual precipitation (4 to 15 in.) and strong winds over the coastal plains.

The maritime influence, as would be expected, is strongest in summer and diminishes gradually with distance inland toward the Brooks Range. Hence, inland stations experience higher maxima in summer and lower minima in winter than do coastal stations.

The ground is generally snow covered from mid-September until early June. Although some snow falls during all months, most of the July and August precipitation is in the form of rain.

Much of the North Slope is cloudy owing to the prevailing easterly wind off the Arctic Ocean. The cloud types are mainly low stratus and fog; cumuli forms are rare. Peak cloudiness occurs during August and September when the ocean is open.

Interior Alaska

Generally, this is the region between the Brooks Range and the Alaska Range but includes part of the Copper River Basin. The dominant climatic influence is continental. Due to the seasonal variation in solar radiation, extreme temperatures may vary from highs of 80-90°F (27 to 32°C) to lows of -60°F (-51°C).

Precipitation and cloudiness reach their maximum in the summer months. Thunderstorms are more prevalent in this area than in other regions of Alaska. Wind speeds are generally low except in local sites near mountain ranges and valleys. Winter storms, drainage, and venturi effects may produce wind speeds in excess of 60 mph (52 knots) at such locations (e.g., Big Delta).

Meteorological and Geophysical Phenomena Which Could Hinder Logistics in Alaska

A number of meteorological and geophysical phenomena are present in Alaska which make certain logistical operations and activities more difficult to accomplish than in the more temperate climate zones. This subsection defines and briefly describes phenomena which could be detrimental to logistic operations. The information in this section is an extension of similar data presented in Reference 8.

Optical Phenomena

a. Terrestrial Refraction (Mirages). The high frequency of temperature inversions, especially in the Arctic zones of Alaska, results in greater-than-normal refraction in the lower atmosphere, causing mirages which distort the shapes and positions of objects. This abnormal refraction may lift into view objects that lie beyond the horizon (looming) or sink below the horizon objects that would normally be visible (sinking).

b. Terrestrial Scintillation (Optical Haze). Optical haze is produced by irregular refraction effects caused by passage across the line of sight of air parcels with densities differing slightly from that of their surroundings. The effect becomes quite pronounced, with strong isolational heating of the earth's surface causing marked thermal turbulence in the surface layer of air. Optical haze blurs the landscape, making it difficult to identify.

c. Whiteout. Whiteout is an atmospheric optical phenomena in which the observer appears to be engulfed in a uniformly white glow. Neither shadows, horizon, nor clouds are discernible; depth perception and orientation are completely lost. Two conditions produce whiteout: 1) a diffuse, shadowless illumination and 2) a uniformly monochromatic, white surface. In polar regions these conditions occur frequently.

Whiteout can occur in a crystal-clear atmosphere under a cloud ceiling, with ample, comfortable light and a visual field filled with trees, telephone poles, Quonset huts, and oil drums. However, if mountains or patches of sky are visible the situation is mitigated considerably.

Whiteout is generally a problem to pilots in landing, take-off, and taxiing. Low flying, at altitudes of approximately 300 meters above the terrain, is particularly hazardous and has resulted in numerous accidents. Ground operations are also impaired, whether they involve walking or the use of vehicles.

d. Snow Blindness (Niphablepsia). Niphablepsia is impaired vision or temporary blindness caused by sunlight reflected from snow surfaces. Since the angle of the sun's rays is always relatively low in the Arctic regions and because a very high percentage of low-angle sunlight is reflected by a snow surface, there is an unusually high intensity of light striking the eye from below, where it is not protected. Since the northern sunlight has a higher-than-normal percentage of ultra-violet, the eyes can become painfully inflamed or burned if they are not shielded.

Wind-Related Phenomena

a. Wind Chill (Hypothermia). If the air temperature is below body temperature, a person will lose heat to the atmosphere, the greater the difference, the greater the heat loss. If the wind is blowing, the rate of heat loss will be increased. Air temperature and wind velocity are the two major environmental factors affecting body heat loss. Wind chill units are kilo-gram-calories per square meter per hour -- a measure of cool-ing or chilling.

In the present system, exposed flesh freezes at a wind-chill value of 1,500 kilogram calories per hour per square meter. Some mean monthly wind-chill values[9] for the month of January for several locations in Alaska are:

Barrow	1650	Cold Bay	1080
Nome	1340	Anchorage	1040
Bethel	1390	Cordova	822
Fairbanks	1110	Juneau	970

b. Drifting and Blowing Snow. Blowing snow constitutes a real hazard for land and air operations between October and April. Snowfall is most frequent in autumn and late winter when average wind velocities are highest, causing the mid-winter period to have the highest number of days on which blowing snow restricts visibility.

Winds of only 7 m/s (16 mph or 14 knots) will lift the powdery arctic snow in the treeless plains. Blowing snow, which usually does not extend more than 10 or 15 meters into the air, may be a local condition lasting for only a few hours or, when associated with cyclonic activity, may last for several hours.

c. Hurricane-Velocity Winds. Frequent cyclonic storms through most sections of Alaska expose several locations to very high wind speeds of 90 knots or more on occasion. Wind velocities approaching 90 knots are also experienced near locations associated with the mountainous terrain and valleys. The sudden onset and severity of such winds poses a definite hazard for most land, water or air operations.

d. Turbulence. There are four general regions in the atmosphere in which turbulence is likely to be strong:

- near the ground, where and when the horizontal and vertical windshear is large. Turbulence is generally diurnal, being more prevalent during daytime than at night,

- in convective clouds;

- in the vicinity of jetstreams (clear air turbulence) and vigorous frontal systems, where convection and large vertical and horizontal windshear are present;

- in the airflow leeward of mountains or small hills where large windshears are frequently developed at some distance away from the mountain.

Fog Phenomena

a. Low Humidity. A feature of the atmosphere in any cold climate is its low water vapor capacity. Any water vapor added to the cold Arctic air quickly saturates it. A low, clinging "steam fog" is thus frequently seen during the Arctic winter over open water. In extreme cases, it may reach an altitude of 1500 meters from the water surface.

b. Ice-Crystal Haze. When temperatures are very low, radiative cooling causes the water vapor to sublimate as ice crystals, forming what is generally called "ice-crystal haze." The thickness of this haze zone will depend on the height of the surface inversion but it may reach 2,500 meters, cover large areas and reduce visibility to as low as 3 to 6 km (2 - 4 miles). However, looking down from the air, the ground is usually visible and the horizon only blurred.

c. Ice-Fog. At temperatures of about -37°C (-35°F) and colder, water vapor sublimates on hydrocarbon molecules, forming an ice-crystal fog which is characteristic in the immediate vicinity of human settlements during very cold weather. Other sources can be open areas of water, herds of animals, and volcanoes.

d. Supercooled Fog (Cold Fog). Fog composed of suspended liquid water droplets at temperatures below 0°C is called "super-cooled fog." Experiments on cold fog dissipation are in progress in Alaska.[10]

Ice Phenomena

a. Freezing Precipitation and Ice. The atmospheric freezing level is often near the earth's surface in Alaska, hence extremely heavy icing conditions can be encountered in flight. Occasionally freezing precipitation will form on surfaces, resulting in extremely hazardous operational conditions.

b. Glaze Ice. Ice is readily formed on exposed objects by the freezing of supercooled water deposited by rain, drizzle, fog, spray, oı condensed supercooled water vapor. Factors which favor glaze formation are large drop size, rapid accretion, slight supercooling and slow dissipation of heat of fusion.

Ships and other objects may accumulate large amounts of ice during these icing conditions, resulting in difficult working and operating conditions.

Water Phenomena

a. Sea Ice.[8] Sea ice forms when the water temperature reaches 29°F (-1.7°C). Two types of ice exist in the northern seas - winter ice and polar ice. Winter ice occurs in the many openings scattered throughout the polar ice pack as well as in open water of the adjacent seas. It is often churned into fragments by strong winds and surface currents and becomes winter drift ice. Sea ice makes ship navigation difficult to impossible, depending on its thickness and bulk.

b. Immersion Hypothermia.[11] Hypothermia is defined as a subnormal body temperature. Immersion hypothermia involves a loss of body heat to water. The approximate survival time of human beings in the sea is directly related to sea surface temperatures (Table 4-19). The survival time given in Table 4-19 can be considered only a first order approximation since experimental data do no incorporate many uncontrollable physiological variables.

TABLE 4-19

IMMERSION HYPOTHERMIA - RELATION OF WATER TEMPERATURE TO APPROXIMATE SURVIVAL TIME OF HUMANS IMMERSED IN THE SEA

Water Temp. (F)	Exhaustion or Unconsciousness	Expected Time of Survival
32.5	15 min.	15-45 min.
32.5-40.0	15-30 min.	30-90 min.
40-50	30-60 min.	1-3 hr.
50-60	1-2 hr.	1-6 hr.
60-70	2-7 hr.	2-40 hr.
70-80	3-12 hr.	3-Indef.
80	Indef.	Indef.

Source: Climatological and Oceanographic Atlas for Mariners, vol. II, North Pacific, (20 years of record)

Land Phenomena

a. Permafrost. Permafrost[12] is defined as that part of the lithosphere in which a naturally occurring temperature below 0°C (32°F) has existed for two or more years. Permanently frozen ground is found in most of Alaska. It is continuous in the Arctic and becomes discontinuous and then sporadic or isolated as one proceeds south. Only the southern coasts are free of permafrost. Permafrost areas usually develop marsh and tundra characteristics. Depths may vary from a few feet to 1300 feet.

b. Freeze-Thaw Cycle. Permafrost is overlain by a layer of seasonally frozen ground or water. In the spring with the increase in ambient temperature the frozen ground, lakes and rivers begin to melt, causing the land surface to become very

unstable. In the colder regions of Alaska this thawing prohibits the movement of vehicles and landing of aircraft. In addition, melting of glaciers, snow and ice packs, and rivers may lead to flooding; especially if ice jams occur on rivers.

In the fall and early winter, with the fall in ambient temperature, the land surface eventually becomes frozen and compact enough to support transportation.

4.4.6 Airports and Landing Strips

Airports, landing strips are generally well-dispersed throughout the entirety of Alaska, with the major exception being the interior regions north of the Brooks Range. The Alaskan Supplement of the U.S. Government Flight Information Publication[13] lists approximately 500 active aerodromes. Table 4-20 is a summary of selected facilities within Alaska which could accommodate an HC-130 at least on a seasonal basis. These facilities could serve potentially as the terminus for primary air transportation logistic operations. The facilities considered adequate for HC-130 operations are generally those with a runway over 4,000 feet long, although Air Force Stations with somewhat shorter runways are included.

More than thirty active Air Force, Army, Coast Guard, and Navy airfields exist statewide. Personnel at these facilities would presumably be available for unloading aircraft and other field support functions. Instrument landings are possible at almost all military facilities, although many of the Air Force Stations are normally limited to daylight operations. Fuel is not available at most of the Coast Guard and Air Force airport facilities in remote areas.

The two major international airports in Alaska are at Anchorage and Fairbanks. Major trunk airports which normally have equipment for instrument landings, fuel, snow removal equipment, and lighted runways are located at:

Aniak	Haines	Kotzebue
Annette Island	Homer	McGrath
Barrow	Hoonah	Nome
Bethel	Juneau	Petersburg
Cold Bay	Kenai	Prudhoe Bay
Cordova	Ketchikan	Unalakleet
Dillingham	King Salmon	Wrangell
Galena	Kodiak	

TABLE 4-20

LARGER AERODROMES WITHIN ALASKA

Aerodrome	Nearest City or Town	Longest Runway (ft)	Fuel Available	Runway Lighting Yes	Runway Lighting No	Radio Aids To Navigation Yes	Radio Aids To Navigation No	Comments
Adak NS	Adak	7,800	Avgas JP-5	X		X		Year-round
Allen, AAF	Fort Greely	7,500	Avgas JP-4	X		X		Year-round
Anaktuvuk Pass	None	4,400	None		X		X	Unattended
Anchorage Intl.	Anchorage	10,900	All types	X		X		Year-round
Aniak	None	5,000	Avgas	X		X		Attended daylight only
Annette Island	Ketchikan	7,500	Avgas, Jet fuel	X		X		Year-round
Barter Island DEW Sta.	-	4,800	Jet fuel	X		X		Attended daylight hours
Beaver	-	4,100	None		X		X	Unattended
Beluga	Tyonek	5,000	None	X			X	Year-round
Bethel	Bethel	6,400	Avgas, Jet fuel	X		X		Year-round
Bettles	-	5,200	Avgas, Jet fuel	X		X		Year-round
Big Mountain AFS	-	4,200	None	X		X		Year-round
Birchwood	Anchorage	4,000	Avgas	X			X	Attended daylight hours
Bob Baker Mem	Kotzebue	4,000	Avgas		X		X	Unattended
Campbell Airstrip	Anchorage	5,000	None		X		X	Unattended; skis only in winter
Cape Lisburne AFS	-	5,000	None	X		X		Daylight operations only
Cape Newenham AFS	-	4,100	None	X		X		Daylight operations only
Cape Romanzof AFS	-	4,000	None		X	X		Daylight operations only
Cape Sarichef AFS	-	3,500	None	X		X		
Casco Cove CGS	Attu	6,?00	None	X			X	
Chaix Hills	Icy Bay	4,200	None		X		X	Unattended
Chandalar Lake	-	4,500	None		X	X		Unattended
Chisana	-	4,200	None		X		X	
Circle Hot Springs	-	4,000	Avgas	X			X	Unattended
Clear MEWS	Nenana	4,000	None	X			X	Operation only at reduced weight
Coal Creek	-	4,000	None		X		X	Unattended
Cold Bay	-	10,100	Avgas, Jet fuel	X		X		Year-round
Cordova Mile 13	Cordova	7,500	Avgas	X		X		Year-round
Dahl Creek	Kobuk	3,900	None		X		X	Unattended
Deadhorse	Prudhoe Bay	5,000	Avgas, Jet fuel	X		X		Year-round
Dillingham	-	4,800	Avgas	X		X		Year-round
Drift River	-	4,300	None	X			X	Year-round
Driftwood Bay AFS	-	3,500	None	X		X		On Unalaska Island
Dutch Harbor	-	4,300	Avgas		X		X	
East Fork	Prudhoe Bay	6,000	None	X			X	Unattended
Eielson AFB	Fairbanks	14,500	Avgas, JP-4	X		X		Year-round
Elmendorf AFB	Anchorage	10,000	Avgas, JP-4	X		X		Year-round
Fairbanks Intl.	Fairbanks	10,300	All types	X		X		Year-round
Farewell	-	5,000	None	X		X		Year-round
Flat	-	4,100	Avgas		X		X	Unattended
Fort Yukon	-	5,000	Avgas, Jet fuel	X		X		Year-round
Galena	-	6,600	Avgas, JP-4	X		X		Year-round
Gambell	-	4,500	None	X			X	Unattended St. Lawrence Island
Goose Bay AAF	Anchorage	5,000	None	X			X	Unattended

TABLE 4-20 (Continued)

Point Barrow NARL	Barrow	5,000	Avgas, Jet fuel	X		X		
Point Hope	-	4,100	Avgas	X			X	Unattended
Point Lay DEW Sta.	-	3,500	None	X		X		
Port Clarence CGS	-	4,500	Avgas	X		X		
Port Heiden	-	7,500	Avgas	X		X		Unattended; soft when wet
Port Moller AFS	-	3,500	None	X		X		
Prudhoe Bay	-	5,500	None	X		X		
Ralph Calhoun Mem.	Tanana	4,400	Avgas	X		X		
Ralph Wien Mem.	Kotzebue	5,900	Avgas, kerosene	X		X		Year-round
Red Devil	-	4,000	Avgas		X		X	Unattended; runway soft
Sagwon	-	5,800	Avgas, Jet fuel		X		X	
St. Marys	-	6,000	None	X		X		
St. Paul Island	-	5,100	None	X		X		Unattended
Sand Point	-	3,800	Avgas		X		X	Unattended; on Popof Is.
Sandy River Federal 1	Port Moller	4,000	None		X		X	Unattended; not maintained
Savoonga	-	4,000	None	X			X	St. Lawrence Island
Seward	Seward	4,700	Avgas	X			X	Attended daylight
Shemya AFB	Atka	10,000	Avgas, JP-4	X		X		Year-round
Sitka	Sitka	5,000	Avgas, Jet fuel	X		X		Year-round
Sitkinak CGS	-	4,500	None	X		X		
Soldotna	Soldotna	5,000	Avgas	X		X		Year-round
South Naknek No. 2	King Salmon	3,600	None	X			X	Unattended
Sparrevohn AFS	-	4,100	None	X		X		Daylight operations only
Stampede	-	4,300	None		X		X	Unattended
Summit	-	5,000	None	X		X		Unattended
Talkeetna	-	4,000	Avgas, Jet fuel	X		X		
Tanacross	-	5,100	None		X		X	Unattended
Tatalina AFS	-	3,800	None	X			X	Daylight operations only
Tin City AFS	-	4,700	None	X		X		Daylight operations only
Trading Bay Production	-	4,500	Avgas	X			X	
Umiat	Umiat	5,400	Avgas	X			X	Unattended; maintenance discontinued
Umnak	-	8,100	Avgas	X		X		Unattended
Unalakleet	-	6,000	Avgas	X		X		No winter maintenance
Upper Hannum Creek	-	4,000	None		X		X	Unattended
Valdez 2	Valdez	4,400	Avgas, Jet fuel		X		X	Unattended
Wainwright AAF	Fairbanks	8,700	JP-4	X		X		Year-round
Wainwright DEW Sta.	-	3,500	None	X		X		
West Kavik	-	5,200	None		X		X	
West Kuparuk	Prudhoe Bay	5,000		X			X	Unattended; not maintained
Wien Arctic Village	Arctic Village	4,400	None		X		X	Unattended
W. Post/ W. Rogers Mem.	Barrow	6,500	None	X		X		Year-round
Wrangell	Wrangell	5,000	Avgas		X	X		Daylight only
Yakataga	-	4,900	None		X	X		Unattended; daylight only
Yakutat	Yakutat	7,800	Avgas, Jet fuel	X		X		Year-round

Granite Mtn AFS	-	3,900	None	X		X		
Gulkana	Glenallen	4,200	Avgas, Jet fuel	X		X		Attended daylight hours
Gustavus	-	7,500	None	X		X		No winter maintenance
Haines	-	4,600	Avgas		X	X		Unattended
Hog River	-	4,000	None		X		X	Unattended
Homer	-	7,400	Avgas	X		X		Year-round
Hooper Bay	-	4,000	None	X			X	Unattended, weight restriction
Hughes	-	4,600	None		X		X	Attended daylight only
Illiamna	-	5,000	Avgas	X		X		Year-round
Indian Mtn AFS	-	4,100	None	X		X		Daylight operations only
Jensens	-	4,700	None		X		X	Unattended
Juneau Muni.	Juneau	8,400	Avgas, Jet fuel	X		X		Year-round
Kad River	-	5,400	None		X		X	Unattended
Kalakaket Creek AFS	-	4,000	None	X		X		
Kavik River	-	5,900	None	X		X		
Kenai Muni.	Kenai	7,500	Avgas, Jet fuel JP-4	X		X		Year-round
Ketchikan Intl.	Ketchikan	7,500	Avgas, Jet fuel	X		X		Year-round
King Cove	Cold Bay	4,000	None		X		X	Unattended, no facilities
King Salmon	-	8,500	Avgas, Jet fuel JP-4	X		X		Year-round
Kodiak	Kodiak	7,500	JP-4	X		X		Year-round
Kulik Lake	-	4,600	Avgas		X		X	Attended May-Sept., Daylight only
Lonely DEW Station	-	3,800	None	X		X		
May Creek	McCarthy	4,300	None		X		X	Unattended
McGrath	-	5,600	Avgas, Jet fuel	X		X		Year-round
Merrill Field	Anchorage	4,000	Avgas, JP-4	X		X		Year-round
Metro Field	Fairbanks	4,600	Avgas		X		X	Attended daylight
Middleton Island	-	5,100	None	X		X		Unattended, soft in spring
Minchumina	-	4,600	None		X	X		Not maintained
Moses Point	-	4,600	None		X	X		Unattended
Mt. Mckinley Natl. Park	-	5,000	None		X		X	Unattended
Nenana Muni.	Nenana	6,200	Avgas, Jet fuel	X		X		
Nikolai Creek	Tyonek	4,100	None		X		X	Unattended
Nikolski AFS	-	3,500	None	X		X		On Umnak Island
Nome	Nome	6,000	Avgas, Jet fuel, JP-4	X		X		Year-round
Northeast Cape AFS	-	5,000	None	X		X		On St. Lawrence Island, Daylight operation
North Shore	-	8,400	None		X		X	Unattended, Umnak Island
Northway	-	4,300	Avgas, JP-4	X		X		Year-round
Oliktok DEW Sta.	-	4,000	None	X		X		
Painter Creek 1	-	5,000	None		X		X	Unattended
Petersburg	Petersburg	4,600	Avgas	X		X		Unattended
Pingo	Prudhoe Bay	6,000	None	X			X	Unattended, not maintained
Platinum	-	4,000	Avgas	X		X		Unattended, dangerous when wet

The remaining airports (non-military and not major trunk airports) are often unattended, not maintained during winter, and generally restricted to daylight operations. However, any of these airfields could be made available to HC-130's by setting up a portable tower and runway lights using either a helicopter or light plane in advance.

4.4.7 Ports and Harbors

The availability of suitable docking and terminal facilities or even sheltered waters for the transfer of personnel and equipment is very limited over considerable stretches of the Alaska coastline. The lack of sheltered waters precludes general usage of small boats for field operations associated with oil spill response in virtually all marine waters surrounding the mainland. Annual sea ice in the Bering Sea, Arctic Ocean, upper Cook Inlet, and selected Bays in the Gulf of Alaska Region further hamper operations of all vessels, particularly smaller vessels.

The paragraphs below discuss the availability of ports, harbors and sheltered waters by region as they apply to area access. The problems of access are primarily related to marine spills, although vessels could conceivably be used as primary transportation vehicles for onshore spills. The availability of fuel supplies and services at the various ports is also included.

Dixon Entrance to Cape Spencer

Numerous deepwater ports, harbors and areas of shelter exist throughout the inside waters of the Alexander Archipelago. The Southeast Alaska region is the only large marine area of the State where the use of vessels smaller than cutters is possible year-round. Even in this region, extreme caution is required during operation of smaller vessels in the larger straits and sounds during winter months. Towns or villages

with docking facilities and supplies are generally located within 60 nautical miles of any point in these waters. The following summary includes the major ports in southeast Alaska where services and supplies are available:[14]

<u>Metlakatla</u>

Groceries, boat fuel (both limited)

<u>Ketchikan</u>

Groceries, air charter services, divers, electronic supplies and repairs, marine engine service, marine supplies, fuel (diesel, stove and gasoline), shipyards and welding.

<u>Craig</u>

Groceries, fuel (diesel and gasoline) and marine supplies.

<u>Wrangell</u>

Groceries, electronic repair, marine service and supplies, fuel (diesel, stove and gasoline), shipyard, welding and air charter services.

<u>Petersburg</u>

Groceries, electronic repair, marine service and supplies, fuel (diesel, stove and gasoline), shipyard, welding and air charter services.

<u>Kake</u>

Machine shop and welding.

<u>Sitka</u>

Groceries, electronic repair, marine service and supplies, fuel (diesel, stove and gasoline), shipyard, welding and air charter services.

Hoonah

Groceries, fuel (diesel, stove and gasoline) and marine service and supplies.

Haines

Machine shop, welding and air charter services.

Juneau

Groceries, electronic repair, marine supplies, fuel (diesel, stove and gasoline), shipyard, divers, welding and air charter services.

Pelican

Groceries, marine service and supplies, welding and fuel (diesel, stove and gasoline).

Gape Spencer to Cape St. Elias

The distance between Cape Spencer and Cape St. Elias following the coast is approximately 290 nautical miles. The only settlement accessible by water where docking facilites and supplies are available is Yakutat. Protected Anchorage along the coastline from slightly north of Cape Spencer to Cape St. Elias is found only in Lituya Bay, Yakutat Bay and Icy Bay. Yakutat Bay is the best anchorage between Cape Spencer and Prince William Sound.[15] Entrance to all of these three major bays between Cape Spencer and Cape St. Elias is very difficult or dangerous during heavy weather. Lituya Bay can be entered safely only during slack tide. Low sandy ocean beaches cut by streams predominate along the coastline below Ocean Cape. The coastline is steeper and more rugged between Point Manly and Cape Suckling and includes two very large tidewater glaciers (Bering and Malspina).

Prince William Sound to Cook Inlet

Cape St. Elias to Cape Douglas

The coastline between Cape St. Elias and Cape Douglas spans approximately 300 nautical miles. Major bodies of water with extrances along the coastline are Prince William Sound and Cook Inlet. The coastline of the Gulf of Alaska between Cape St. Elias and Cape Douglas is generally high and rugged. Coastline is frequently indented by long fiorda-like bays which generally afford protection. The only settlements available by water with docking facilities and marine supplies are Cordova on the eastern coastline and Seward in Resurrection Bay. Both cities have groceries, fuel (diesel, stove and gasoline), marine supplies, electronic service, divers and welding services available. Coast Guard vessels are also stationed in each of the cities.

Prince William Sound

Prince William Sound covers an area of approximately 2,500 square miles. There are numerous islands and long deep bays throughout. Although sudden wind squalls are common, protection from the weather is never far away due to the numerous islands. Shorelines are predominantly rather steep and rocky. Three settlements are accessible by water with docking facilities, supplies and services - Valdez, Whittier and Cordova. These three cities have had limited services and supplies available in the past. However, Valdez is changing very rapidly due to construction of the pipeline terminal there.

Cook Inlet

Cook Inlet extends inland over 200 nautical miles from the Gulf of Alaska. Safe Anchorages within Cook Inlet include Port Graham, Seldovia Bay, Kasitsna Bay, Coal Bay (behind Homer Spit), Iniskin Bay, Tuxidni Channel and Knik Arm. The shoreline is generally long mud flats throughout the middle and upper

reaches. Cook Inlet is characterized by extreme tides (about 30 feet at Anchorage) and tidal currents in the upper reaches. The upper part of Cook Inlet is obstructed by ice during severe winters.

Docking facilities, services and supplies are available at the following ports:

Port Graham

Groceries and limited fuel and marine supplies

Seldovia

Groceries, marine service and supplies, welding and fuel (diesel, stove and gasoline)

Homer

Groceries, marine service and supplies, welding electronic supplies and service, and fuel (diesel, stove and gasoline).

Kenai

Groceries, electronic supplies and service, welding and fuel (diesel, stove and gasoline)

Nikiski and Draft River Terminals

Oil tanker loading terminals located on the east and west sides of Cook Inlet just north of Kalgin Island.

Anchorage

All types of provisions, fuel and services are potentially available in Anchorage.

Cape Douglas to Unimak Pass

The distance between Cape Douglas and Unimak Pass following the coastline is approximately 530 nautical miles. Kodiak Island is south of Cape Douglas across the Shelikof Strait.

The coastline is generally steep and rocky and reefs are common along the entire length. Protected anchorages are scant along the eastern portion from Cape Douglas to Chignik Bay. The only accessible settlements along the southern coastline of the Alaska Peninsula between Cape Douglas and Unimak Pass are Chignik and Cold Bay. Limited supplies and fuel are available at each location.

The town of Kodiak on Kodiak Island is a major supply base for fishing vessels working throughout the Gulf of Alaska. Practically any type of provision, fuel or service is available there. There is, of course, the large Coast Guard Base and Air Station near Kodiak. Processing plants and villages are located on many bays around the perimeter of Kodiak Island such as Akhiok, Karluk, Larsen Bay and Port Lions. Limited supplies and fuel are available at these sites (sometimes seasonally).

The town of Sand Point in the Shumagin Islands has docking facilities, marine supplies and services, some groceries and fuel available. The town of Dutch Harbor on Unalaska Island west of Unimak Pass is the site of fish processing plants. Docking facilities, marine services and supplies and marine fuel are available there.

<u>Bristol Bay</u>

Bristol Bay is generally considered to be the waters of the Bering Sea east of a line drawn between Cape Sarichef and the Kuskokwin River.[15] Conditions in the Bristol Bay area are, perhaps best summed up by the Coast Pilot No. 9:

> "The Bristol Bay region must be regarded as a dangerous locality to navigate; it is only by the greatest vigilance and constant sounding that disaster can be avoided upon approaching the land. This is particularly true of the northeast arms and approaches which receive the waters of the great salmon streams on

which the Bering Sea canneries are located. The rivers discharge a great quantity of water into wide indentations which open on the arms of the great bay. The banks of the rivers are frequently marshy and generally muddy. The discolored water of the rivers is charged with a large amount of sediment, which, when deposited, forms shoal areas.

The funnel-shaped configuration of the bay and river entrances creates tidal currents of great force, reaching, at times, velocities up to 6 knots. The diurnal range of tide averages about 18 feet at the river entrances. Vast areas of shoals uncover at low water, leaving only pools and narrow channels between them."

Limited provisions, marine supplies and marine fuel are available at the fish processing plants, towns and villages throughout the area. The fish and crab plants are normally operated only during the summer salmon season. Locations where docking facilities and supplies are available, at least seasonally, include:

- Port Moller
- Port Heiden (Meshik)
- Pilot Point
- Ugashik
- Egegik
- Nanek
- South Nanek
- Libbyville
- Koggiung
- Ekuk
- Clarks Point
- Dillingham
- Eek

Many of the wharves at the upper end of Bristol Bay are dry at low water due to the large tidal range.

Etolin Strait to Barrow

The northern portion of the Bering Sea and coastal areas of the Chukchi Sea are typified by shallow waters and lack of protection from the prevailing weather. The only good harbor close to the Bering Strait is Port Clarence.[15] The coastline is generally low and marshy. There are apparently no docking facilities between Etolin Strait and Barrow. Limited supplies and fuel are generally available at the following villages and cities:

- Hooper Bay
- Alakanuk
- Kwiguk
- Hamilton
- St. Michael
- Unalakleet
- Golovin
- Nome
- Teller
- Wales
- Kotzebue
- Kivalina
- Point Hope
- Wainwright
- Barrow

Beaufort Sea

The length of coastline between Barrow and the Canadian boundary is approximately 330 nautical miles. Waters are extremely shallow throughout the region--depths of a few feet commonly extend for several miles offshore. The pack ice at Barrow moves far enough offshore to permit navigation only about 3-4 months each summer (late July - early October). Protected anchorages are very limited along the entire coastline for vessels drawing more than ten feet. Ports or harbors are nonexistent.

Supplies and fuel are generally available only at Prudhoe Bay. A limited amount of supplies may also be available at the village of Kaktovik on Barter Island.

4.4.8 Communications Systems

Telecommunications are felt to be secondary only in importance to primary transportation as an element for rapid and effective oil spill response. Two distinct types of communications are required--long-range and field communications. Long-range communications capability is required to initiate the response logistics. Field communications are required thereafter to coordinate the multitude of field activities and safeguard lives in some instances.

Radio communications will be used for all field communications and in all probability also be used as either the total system or initial mobile link for all long range communications. Systems other than radio communications such as telephone and telegraph are generally restricted to the larger towns and cities. Vast areas of the Arctic and Western Alaska presently rely on radio communications and will probably continue to do so in the foreseeable future. Satellite communications to bring television to Alaskan villages is presently being established. However, the use of satellites for the long-range communications required for oil spill response is probably ten or more years away.

The climate, terrain, atmospheric conditions, and surface characteristics (ice, permafrost, etc.) cause radio systems throughout much of Alaska to behave differently than in temperate zones. Table 4-21 indicates the functions for which the various frequency allocations are commonly used.[16]

Propagation modes and frequency ranges useful for various distances in the Arctic are shown in Table 4-22.[16]

VLF and LF systems are not generally used for point-to-point communications in Alaska. VLF fields and LF systems are

TABLE 4-21

COMMUNICATION FUNCTIONS FOR WHICH FREQUENCY ALLOCATIONS ARE COMMONLY USED

Longline: (Open wire line or multiple pair cable)	Very short inter-building and inter-site (less than 16 km-10 miles)
Very Low Frequency (VLF): (3 to 30 kHz)	Standard frequency measurements WWVL 20 kHz, Boulder
Low Frequency (LF): (30 to 300 kHz)	Radio beacons; radionavigation WWVB 60 kHz, Boulder
Medium Frequency (MF): (300 to 3,000 kHz)	Radionavigation; station-to-station mobile
High Frequency (HF): (3 to 30 MHz)	Long-distance skip; station-to-station mobile; distress; emergency
Very High Frequency (VHF): (30 to 300 MHz)	Ionospheric scatter; station-to-station mobile; radionavigation
Ultra High Frequency (UHF): (300 to 3,000 MHz)	Tropospheric scatter; station-to-station mobile; microwave
Super High Frequency (SHF): (3 to 30 gHz)	Microwave

TABLE 4-22

TYPES OF PROPAGATION AND FREQUENCY RANGES USEFUL IN THE ARCTIC FOR VARIOUS PATH LENGTHS

Path Lengths (km)	Propagation Modes	Frequency Ranges
1 to 10	ground wave (surface)	MF, HF
	direct (line of site)	VHF, UHF
10 to 100	ground wave (surface)	MF, HF
	Point to point and refraction	VHF, UHF
100 to 1,000	ground wave (surface)	LF
	sky wave	LF, HF
	tropo-scatter	UHF
	iono-scatter	VHF
	line of site (with relay)	VHF, UHF, SHF
1,000 to 10,000	ducted wave	VLF, LF
	sky wave	LF, HF
	auroral scatter	HF, VHF
	meteor scatter	VHF
	line of site (satellite relay)	UHF, SHF

useful for navigation. LF ground waves travel well over seawater. MF systems are of limited usefulness because of rapid attenuation of the ground wave mode as well as high attenuations on reflections from the ionosphere.[16] Short-range mobile systems, Aids to Navigation beacons and LORAN which operate over water do operate on the MF band in Alaska. HF bands are widely used for station-to-station communications in Alaska. However, the HF band is highly susceptible to blackouts. The blackouts can generally be overcome or minimized by selecting different frequencies within the HF band. VHF and UHF systems are commonly used for aircraft communications. UHF is also most commonly used for short-range, line-of-site, portable field radios.

Long-Range Communications

Direct communication between the On-Scene-Coordinator and Coast Guard District Headquarters or the nearest Base is essential during any oil spill response operation. Effective logistic response will further require a direct link between the On-Scene-Coordinator and personnel at the following locations:

- The supply base
- Vessels and aircraft potentially available for response throughout the state
- National Strike Force
- Regional Response Center and Regional Response Team
- National Response Center
- Alaska Command
- Rescue Coordination Centers
- Environmental Protection Agency
- Marine Inspection Offices
- Appropriate Federal and State Agency Headquarters
- The home office or responsible representative of the individual or company causing the spill

Long distance telephone and telegraph communications in Alaska were controlled by the Alaska Communications Systems (ACS), an agency of the Air Force, until 1971.[16] The commercial portion of the ACS was transferred to RCA Global Communications in early 1971. The ACS "White Alice" network covers most of Alaska and extends over 5,000 route kilometers of multi-plexed radio and telegraph circuits and consists of 23 tropospheric-scatter links operating at about 900 MHz.[16] The larger cities and towns of the state are served by telephone companies using the "White Alice" network. Communication links in the smaller and more remote villages are provided by a bush telephone system (radio/telephone link). Coastal stations of the ACS provide ship-to-shore service.

A DEW Line network covers about 5,000 route kilometers, excluding rearward links, extends from Alaska to the eastern Arctic.[16] The DEW Line network and military portion of the Alaska Communications System are potentially available to the Coast Guard for long-range communications associated with oil spill response if prior agreements are established. The commercial portion of the Alaska Communications System is always available and could be of great value in the Arctic or interior of the mainland.

Coast Guard cutters and aircraft can serve effectively as long range communications centers if available at the spill-scene. The cutters and aircraft can maintain constant contact with Coast Guard bases or stations. The aircraft can further serve as aerial relay stations in otherwise inaccessible areas.

VHF-FM communications for ships or aircraft have been established by the Coast Guard at stations throughout most of Southeast Alaska, the area around Kodiak Island, upper Cook Inlet, and portions of Bristol Bay. Transmitters/receivers at Zarembo Island, Cape Decision and Gravina Island are

remotely controlled from the Ketchikan Base. Transmitters/receivers at Cape Fanshaw and Mud Bay are remotely controlled from Juneau. Independent stations are located at Biorka, Robert Baron, Kodiak, and Anchorage. Transmitters/receivers at Tuklung, Cape Gull, and Seward are remotely controlled from the Kodiak Base.[20]

Portable communications centers are available from the Army and Air Force and have also been developed by the Coast Guard (Emergency Communications Center). The unit is trailer-mounted and therefore somewhat portable. A mobile command post is available at Strike Team bases that weighs approximately 14,000 pounds.[17] The availability of the units only at Strike Team bases outside of Alaska would, however, severely limit the effectiveness for Alaskan oil spills.

Field Communications

Field communications are essential between the On-Scene-Coordinator and personnel, vessels, vehicles and aircraft responding to the spill. Contact between various personnel at the scene is also required. Small portable transceivers are the most effective device for line-of-site communication between individuals over short distances. Field telephones and public address systems can also be used effectively in a more limited sense.

Complete field communications systems developed by the Army would be available to the Coast Guard in Alaska. Field communication kits are also available through the Bureau of Land Management Fire Control Division in Alaska and the Boise Interagency Fire Center in Boise, Idaho. The radio kits developed by the BLM for firefighting are felt well-suited to oil spill response operations. The descriptions of the radio kits included below were provided by Mr. Jerry Merth, Communications Manager at the Boise Interagency Fire Center. The BLM radio kits available are shown in Table 4-23 below:

TABLE 4-23

COMMUNICATIONS KITS AVAILABLE FOR THE 1974 FIRE SEASON

	No. Avail.	Cost	Wt.	Cu. Ft.
Division Radio Kit, Two Frequency	6	$662.37	90#	3.5
Division Radio Kit, Four Frequency	12	$701.82	80#	3.5
Division Radio Repeater Kit	12	$341.23	159#	9.5
Overhead Team Radio Kit	2	$551.86	61#	4.0
Overhead Team Repeater Kit	2	$415.33	93#	4.0
Logistics Radio Kit	2	$713.56	75#	3.5
Logistics Repeater Kit	4	$504.93	156#	5.7
Remote Unit Kit	15	$210.13	144#	4.5
Ground Aircraft Radio Kit	5	$180.87	92#	3.93
Public Address System Kit	6	$180.57	83#	7.3

Figures 4-4 through 4-9 at the end of the section depict typical uses of these radio kits described below.

The Two Frequency Division Radio Kit is designed for smaller fires. One of the two portable transceiver frequencies may be used directly (simplex operation) or through a repeater (duplex operation). The kit includes 16 portable transceivers, 3 headsets, 3 microphones, 4 external radio antennas with adapters, and 3 tape-on antennas for aircraft windows.

The Four Frequency Division Radio Kit is intended for larger fires. The transceivers may be used either directly or through a repeater as one of the available frequencies is a repeater function only. The speaker/mike can be clipped to the collar so the radio does not have to be removed from the belt carriage. The transceivers may be used inside of fixed-wing aircraft or helicopters in conjunction with an adapter. The kit consists of 16 portable transceivers, antennas adaptable to either land vehicles or aircraft, 4 speaker/mikes and 3 earpieces.

The Division Repeater Kit is a battery-operated portable repeater unit designed for hilly or mountainous terrain. One man is required for installation. Suitable antennas, masts and guy wires are included in the kit.

The Overhead Team Radio Kit and Repeater Kit provides communications between the base camp and fire area on separate frequency than used for the other radio kits available. The kit consists of 12 portable transceivers and antennas adaptable to either vehicles or aircraft. The repeater can be installed by one man.

The Logistic Radio Kit and Repeater is designed for large fires where many people are involved. The kit may be used in a variety of ways, i.e., communication between General Headquarters, Zone base camps, airport marshalling areas, etc.,

communications to buses, supply trucks, etc., or at base camp in lieu of portable field telephones. The kit includes 14 transceivers, three speaker/mikes, earpieces and antennas adaptable to vehicles or aircraft.

The Remote Unit Kit is designed to provide a remote base station up to one mile from the base fire camp, GHQ, etc., when using the Division, Two and Four Frequency and Logistic Radio Kits. The kit includes a remote desk set and antenna adaptable to the other radio kits. The remote location distance can be extended up to several miles by connecting with wire.

The Ground Aircraft Radio Kit is a portable battery-operated 360 channel VHF/AM aircraft radio for use at base camp heliports or airports for aircraft control. The kit includes the radio, microphone, headsets and antenna.

The Public Address System Kit is a 50-watt portable Public Address System with three speakers intended primarily for base camp use. The kit includes microphone, three speakers, amplifier and one megaphone (voice gun).

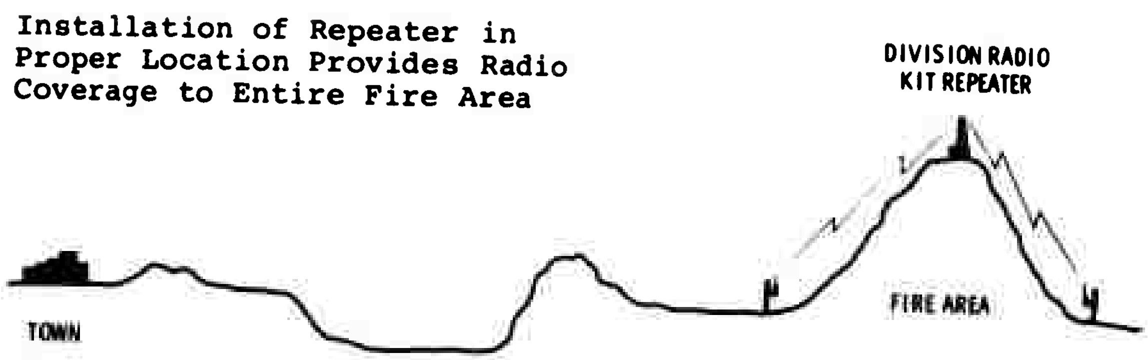


FIGURE 4-4. DIVISION RADIO KIT

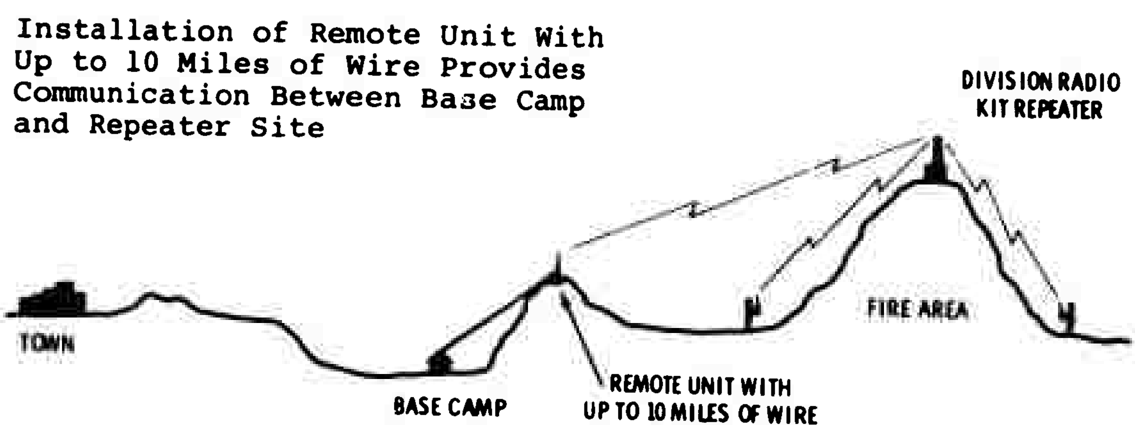


FIGURE 4-5. DIVISION RADIO KIT WITH REMOTE UNIT

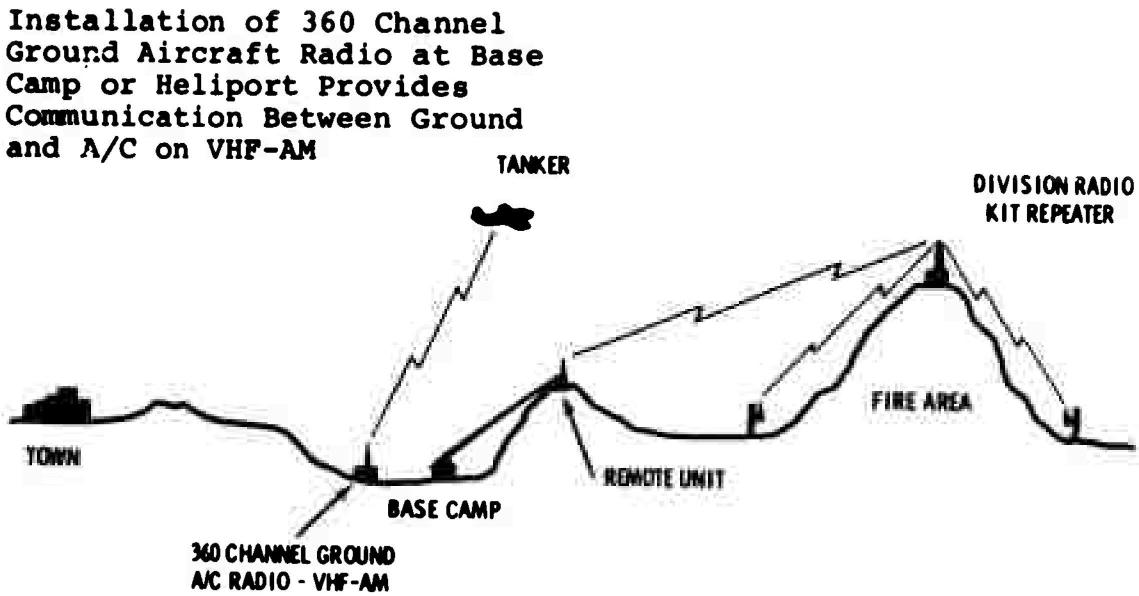


FIGURE 4-6. DIVISION RADIO KIT WITH GROUND AIRCRAFT RADIO KIT

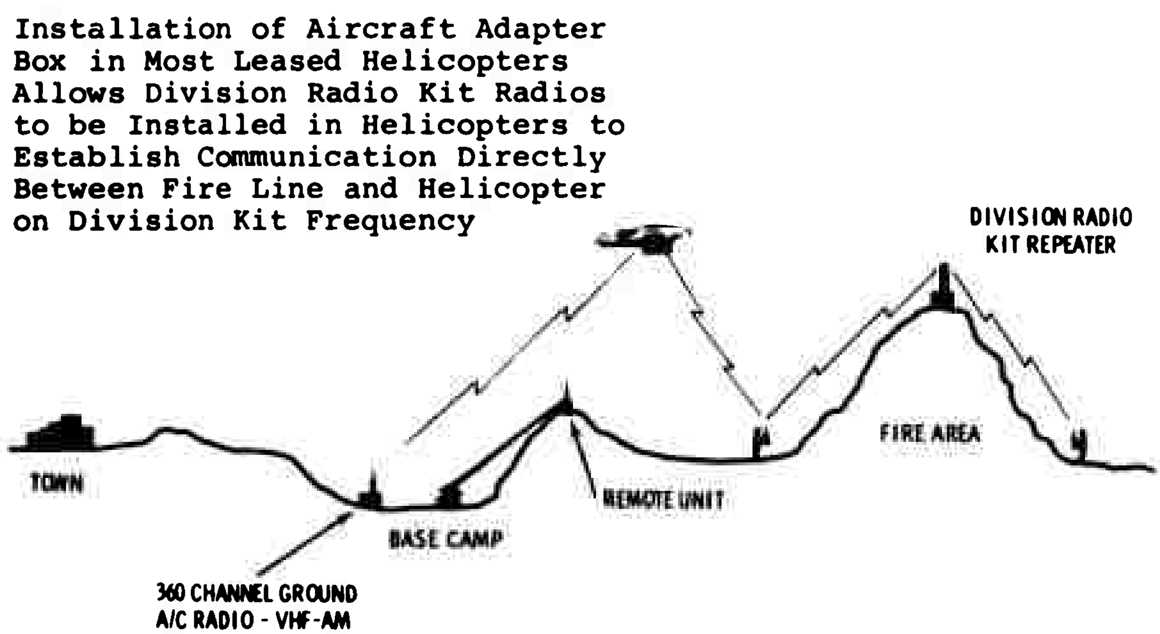


FIGURE 4-7. DIVISION RADIO KIT WITH GROUND AIRCRAFT RADIO KIT AND AIRCRAFT ADAPTER BOX

Installations of an Overhead Team Kit Repeater and Remote Unit Provides Communication Between Fire Camp and Fire Area on a Separate Frequency Than That Used in Either Division or Logistic Radio Kits

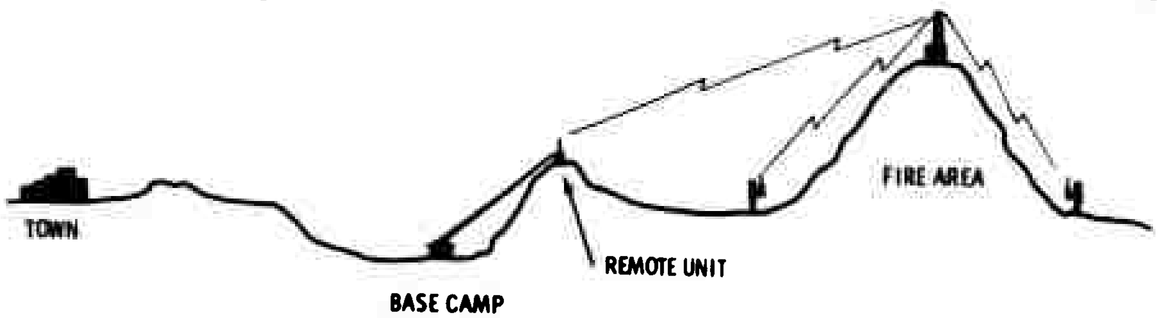


FIGURE 4-8. OVERHEAD TEAM KIT

Installation of a Logistic Radio Repeater Provides for Control of the Camp Area, Vehicles and the Transmission of Logistic Information on a Separate Frequency From That Used With Division Radio Kits

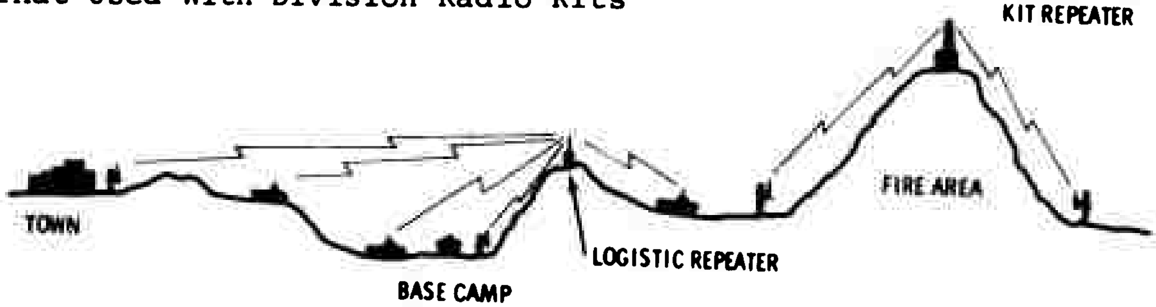


FIGURE 4-9. LOGISTIC RADIO KIT

Atmospherics and Meteorological Effects on Radio Wave Propagation

This section briefly discusses the atmospheric and meteorological phenomena which affect communication systems, particularly radio wave propagation, in Alaska. Much of the material presented in this section was summarized from "Arctic Environment and Resources"[18] and "Radio Meteorology."[19]

Atmospherics

Radio systems in Alaska employ transfers of energy by most of the normal radio frequencies (Table 4-21) and propagating modes, i.e., direct, ground wave, sky wave, ionospheric reflection, etc. Modes which involve contact with the earth's surface or the ionosphere will, in many cases, behave quite differently in Alaska than in temperate zones. Since the ionization profiles of the northern ionosphere differ greatly from those in temperate regions, there are times when high-frequency ionospheric losses in Alaska are much greater than at low latitudes. At these same disturbed times, low-frequency ionospheric losses are often less than at low latitudes.

Radio and visual aurora are characteristic ionospheric phenomena in Alaska. Radio aurora is an ionization which causes certain characteristic types of radio reflection. Radio waves reflecting from ionized aurora usually acquire a random fading rate (100-400 Hz at frequencies of 50-150 mHz) which shifts their spectrum to either side of the carrier frequency. This aurorally-induced modulation may restrict the information band pass of the ionized aurora to about 1 KHz or even less, depending upon the fading present. Band widths of this size prohibit radiotelephone communications by seriously garbling the signal.

However, other narrow bandwidth systems such as CW, radio, and teletype may be received with little loss of intelligibility.

Normal daytime radiowave absorption in the middle and high latitudes is approximately proportional to the 3/4 power of the cosine of the solar zenith angle. In high latitudes several types of abnormal absorption are encountered; their existence and prolonged prevalence has long been known to communicators employing HF and VHF.

Abnormal polar radiowave absorption may be categorized in three groups: sudden ionospheric disturbances (SID); polar-cap absorption (PCA); and auroral absorption (AA). The first two types correlate with solar-flare events.

Sudden ionospheric disturbance (SID) are associated with visible solar flares. They are confined to daylight hours and occur not only in polar regions but simultaneously throughout the entire sunlit hemisphere. They are caused by solar ultraviolet radiation that is absorbed in the D region (45 mi) and creates large ionization. It starts within minutes of the beginning of a solar flare and lasts for several minutes to about an hour.

Polar-cap absorption (PCA) is the most severe absorption event. It starts one to several hours after the solar flare well inside the polar region around the magnetic pole. The absorption is much stronger over the sunlit portion than over the dark portion of the earth. Therefore, the magnitude and geographic extent of a PCA event changes over the polar-cap with the change of illumination during the course of a day. The absorption of HF wave energy can be so strong that HF communication become impossible; this is called polar blackout. Such a blackout lasts for several hours, or several

days in extreme cases, especially when two strong solar flares (and, therefore, two PCA's) occur within a day or two, which happens during periods of sunspot maxima.

Auroral absorptions (AA) are not related to PCA's and SID's but are commonly associated with magnetospheric substorms and aurora. They are short-lived, usually lasting only a few minutes, rarely a few hours. The average absorption in winter is twice that in summer, but from the zone of maximum occurrence their amplitude decreases toward the pole. The absorption has a well-defined peak a few degrees south of the visual auroral oval. Auroral absorption is only one of the many manifestations of precipitating particles (electrons and protons) coming from the magnetosphere into the ionosphere. Other effects are: visible aurorae, magnetic substorms, micropulsations, VLF hiss and chorus, sporadic E, and spread F.

Portions of the Alaska land surface that are covered with snow, ice or permafrost can introduce large losses in the energy of radio surface waves. In the VLF range, as in the LF range with a ground-wave mode, propagation is much more effective over Arctic sea ice than over an ice cap or a permafrost region. Around 15 KHz, the normal attenuation rate over temperate-zone seawater ranges from 1 to 2-1/2 db/600 miles. When the path is over normal land, an attenuation of about 1 to 2 db/600 miles must be added to the sea water rate and when the path is over a region of deep permafrost or an ice cap, an attenuation of about 6 to 20 db/600 miles must be added. The attenuation increase is usually much greater during the day than at night.

At high frequencies (HF, VHF) it is possible to obtain reliable communications over several thousand miles under good conditions. For sea water paths, the ground-wave propagation

mode provides useful communication up to several hundred miles. Over poor Arctic soil or ice caps, the useful range is much less--in some cases less than 6 miles.

Meteorological Effects

Additional variability in the characteristics of received radio and radar fields in the higher frequencies ($\geq$30 MHz) is attributed to temperature, pressure and humidity variations in the lower atmosphere or to the radio refractive index. The radio refractive index is defined as the ratio of the speed of propagation of radio energy in a vacuum to the speed in a specified medium, such as the atmosphere. The refractive index, in practice, is usually measured indirectly by observations of temperature, pressure, and humidity.

The radio refractive index is central to all theories of radio propagation through the lower atmosphere. The atmosphere causes a downward curvature of horizontally launched radio waves which is normally about one-quarter that of the earth. Under certain meteorological conditions, however, the radio energy may be confined to thin layers near the earth's surface with resultant abnormally high field strengths being observed beyond the normal radio horizon. At other times a transition layer between differing air masses (fronts) will give rise to the reflection of radio energy. In addition to these gross profile effects, the atmosphere is quite frequently in a turbulent state with the result that radio energy is scattered out of the normal antenna pattern. The atmospheric radio refraction index, n, always has a value slightly greater than unity near the earth's surface (e.g., 1.0003) and approaches unity with increasing height. In practical application the refractivity is used, where

$$N = (n - 1)10^6 = \frac{77.6}{T}(P + \frac{4810e}{T})$$

and T is temperature, P is pressure and e is the partial pressure of water vapor. The atmosphere, on the average, yields an exponential distribution of N with height, i.e., decreasing exponentially with height.

In Alaska, especially over the continental regions, atmospheric conditions are quite favorable for temperature inversions (an increase in temperature with height with a corresponding decrease in humidity with height). Temperature inversions have a two-fold importance, in that they can be widespread in area and persist over a relatively long period of time, and they exercise a stabilizing influence on air motion so that turbulence is suppressed and strong humidity gradients may develop.

The layer of air within or below the temperature inversion may form a radio duct where a radio ray originating at or near the earth's surface is sufficiently refracted so that it either is bent back towards the earth's surface or travels in a path parallel to the earth's surface, essentially trapping the radio wave. The refractivity N during inversion conditions, due to pressure, temperature and moisture profiles, exhibits a negative gradient. Whenever the rate of change of refractivity from the surface value with height is less than -157 N units per kilometer, a "ducting" condition is said to exist at the surface and certain radio rays will tend to be "trapped" or guided within the surface duct.

Serious disruption in reception from a transmitter above a duct to a receiver within a duct can occur at particular points within the horizon. Wherever these disruptions occur, a corresponding increase in field strength characterized by steady, high, dependable signals is usually expected beyond the horizon. The high signal strength is in keeping with the

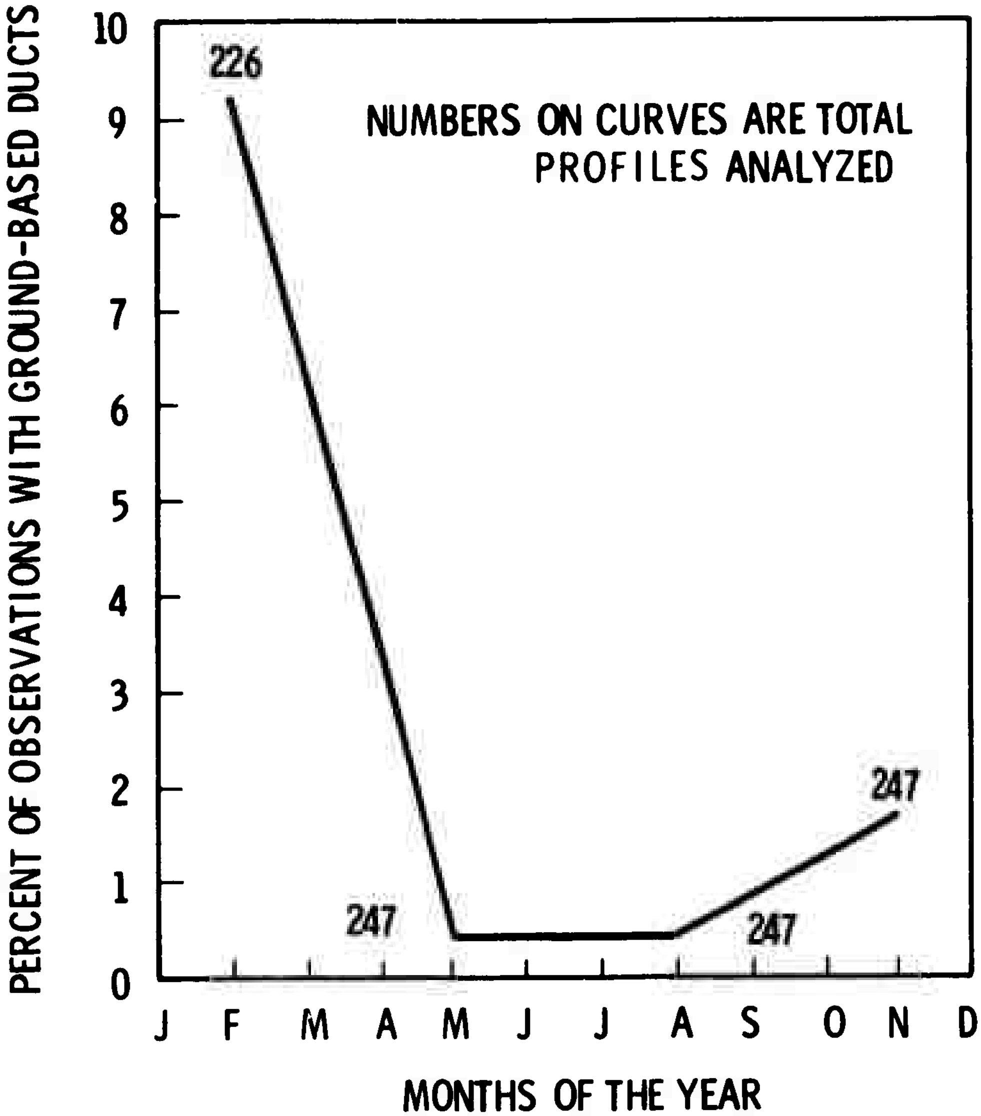
properties of a surface duct. Nevertheless, deep, prolonged fadeouts (drop in power or field strength below a specified level of intensity) can occur in regions beyond the horizon as well as within the horizon.

Radio or radar ducts usually occur no more than 15% of the time. Maximum occurrence of ducts at northern stations in Alaska such as Fairbanks and Barrow is about 9 and 5%, respectively (Figures 4-10 and 4-11). These stations have a wintertime maximum (February) since ducts appear to be associated with temperature inversions with ground temperatures of -25°C or less. Fairbanks is characterized by shallow duct layers with relatively intense refractivity gradients. A maximum gradient of -420N units per kilometer was observed during one winter period.

Maximum occurrence of radio ducts at Anchorage, a station with a partial maritime exposure, is about 1% and occurs in May and August (Figure 4-12). May and November have steep refractivity gradients.

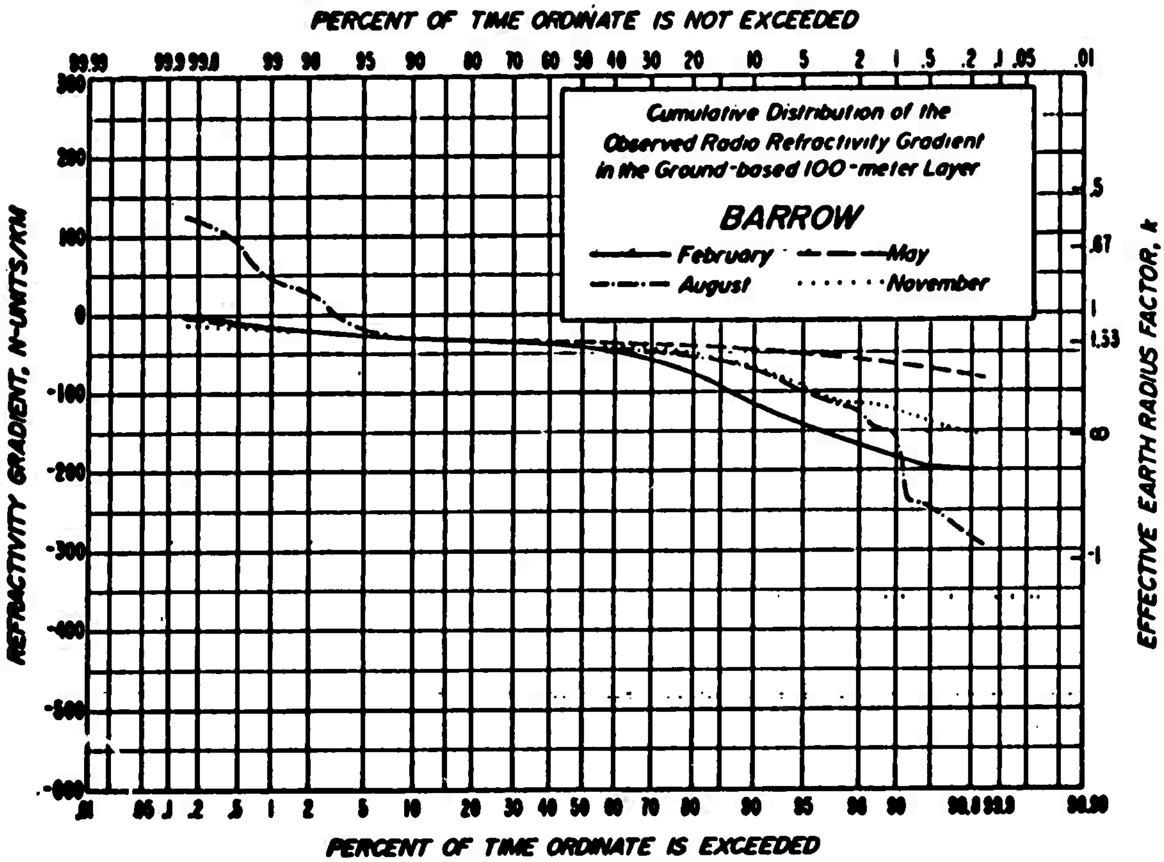
Other Meteorological Effects

A number of other meteorological phenomena and effects may cause variations in the refractive index and attenuation of radio and radar wave energy. Air mass properties and movement (fronts), atmospheric gases, clouds, rainfall and fog have characteristic effects on the radio refractive index or attenuation of the radio wave energy. Details concerning these aspects should be obtained from the references or pertinent radio communication publications.



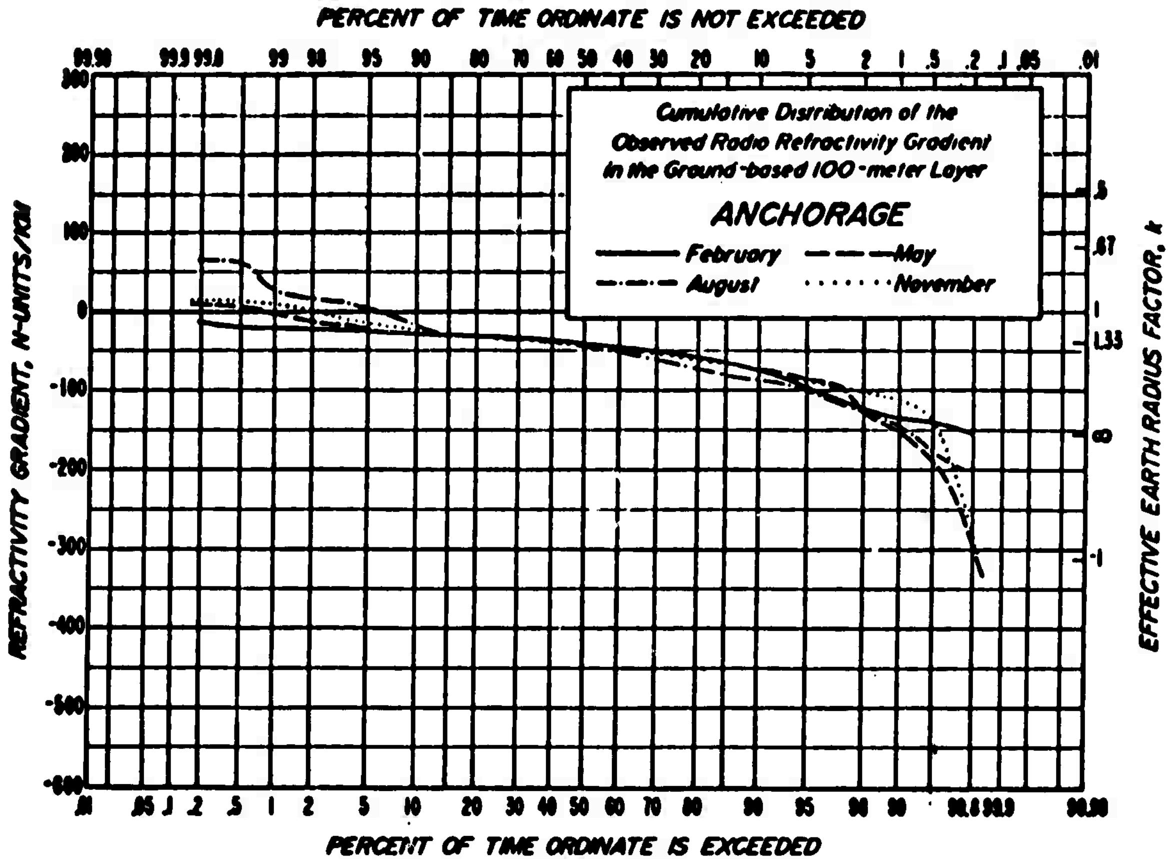
Source: Radio Meteorology

FIGURE 4-10. FREQUENCY OF OCCURRENCE OF GROUND-BASED DUCTS AT FAIRBANKS, ALASKA



Source: C. A. Samson,
Office of Telecommunications,
Boulder, Colorado.

FIGURE 4-11. FREQUENCY OF OCCURRENCE OF THE REFRACTIVITY GRADIENT AT BARROW, ALASKA



Source: C. A. Samson,
Office of Telecommunications,
Boulder, Colorado.

FIGURE 4-12. FREQUENCY OF OCCURRENCE OF THE REFRACTIVITY GRADIENT AT ANCHORAGE, ALASKA

4.4.9 Navigation Systems

A complete Air Traffic Control System has been developed in Alaska.[16] Navigation systems encompass the entire state and the major airports, trunk airports and military airfields have capability for controlled approach using radar. Vessel navigation systems and navigational aids are not as well established throughout all marine waters. Offshore waters have, or will have, LORAN C coverage south of approximately Point Hope in the Chukchi Sea. A Vessel Traffic System (VTS) will be operable in about 1976 to control vessel movements on Prince William Sound.[20]

Normal navigational aids such as lights, fog signals, buoys, day beacons and electronic aids are quite well-established throughout Southeast Alaska and at the entrances to major ports and harbors along the Gulf of Alaska, Cook Inlet, and Kodiak Island. Navigational aids are scant throughout the Bering Sea and virtually non-existent in the Arctic marine waters. Seasonal aids to navigation are provided by the Coast Guard and others in areas of the Bering Sea. Radar transponders with a range of approximately 15 miles are emplaced each summer by the Coast Guard to facilitate shoreline navigation along the Bering Sea coastline.[20] The radar transponders are necessary because the low profile of the shorelines affords poor radar return.

Areas of intense fishing activity or channels leading to canneries are often marked by navigational aids provided by the private individuals involved. Such aids to navigation are non-standard and often unreliable. Local fishermen are often the only current and reliable sources of information concerning hazards to navigation in nearshore waters or inland bays.

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4.5 FIELD SUPPORT

The field support functions discussed below are limited to those relating to personnel sustenance and emergency services. Other types of field support functions such as local transportation and communications are discussed elsewhere. The study framework for field support functions is as follows:

Environmental Description	Manpower Required	Time on Scene (Days)
Moving Pack Ice	20	20
Open Water	25	10
Shorefast Ice	15	15
Tundra	15	15

Field personnel support requirements vary both seasonally and by area within Alaska. The winter environment naturally imposes the most severe stresses on support elements with respect to performance. The winter climate in the arctic and interior regions of Alaska tends toward dry and cold, while winters along the coastal areas of the subarctic regions tend more toward wet and cold. Field support elements for personnel sustenance during response to oil spills must be designed to cope with the range of environmental and working conditions existing throughout the state, regardless of season.

Oil spill response operations cannot be effective if conducted like field exercises in Arctic survival. Personnel must be fed hot food, clothed properly and provided with suitable shelter to maintain effectiveness and morale. Tents are not considered suitable for extended field response operations. Coast Guard capability to support and sustain field operations onshore could not be identified during

interviews at facilities throughout the state. The larger cutters can provide the required personnel sustenance for most marine spills in the sub-Arctic, providing that a cutter is available within 24 hours of the spill location. However, adequate portable shelters and messing facilities need to be developed or procured for inland spill response and Arctic marine spills.

Personnel field support supplies and equipment must be transportable by any aircraft, ship or land vehicle potentially available for primary transportation. An added flexibility could be achieved by packaging all supplies and equipment in containers that could be air dropped or removed by low level parachute extraction from HC-130 aircraft. Air drop capability would eliminate the need for overland transportation or lifting by helicopter from large airstrips to the spill site in locations in the interior where the spill might be as much as 50 miles from the airstrip or airport. Field support equipment should be packaged to allow air transport compatible with the "Metric" 463L cargo handling system weight and cubage allowances for the HC-130 aircraft (10 ft long x 8 ft wide x 8-9 ft high).[1] The eight foot width is desired to permit personnel egress around the container.

Sustaining personnel throughout most of the Arctic and sub-Arctic regions of Alaska is likely to be complicated by the non-performance of equipment or unavailability of supplies such as heating fuel and water. Sewage disposal can be a serious problem due to inadequate drainage in permafrost and the fact that standard chemical toilets may not work properly. Surface water in all regions must be considered contaminated until proven otherwise. All personnel arriving at the scene,

within the first 24 hours, should be completely equipped and prepared for self-sustenance for a period of at least three days.

4.5.1 Quartering

Field quarters are potentially available from the following sources:

- Coast Guard cutters or other large vessels
- Existing government or private facilities at or near the spill location
- Temporary portable shelters (including tents)

The availability of Coast Guard cutters is a matter of opportunity for response within 24 hours at most locations in the Bering Sea and virtually all locations along the Arctic Ocean in either summer or winter. Existing facilities suitable for quartering near most potential oil spill locations are similarly of doubtful availability due to the sparse population throughout Alaska. The availability of suitable existing facilities is discussed for selected sites in Section 5.0. It can be therefore assumed that portable shelters onshore will be required for temporary quarters at many, if not most, of the potential oil spill sites in Alaska. The capability to provide temporary onshore quarters adaptable to the range of climatic and other environmental conditions in Alaska needs to be developed by the Coast Guard. Tents are not felt to be adequate quarters for extended field operations when the more hostile climatic conditions prevail.

Lightweight portable shelters either exist or are under development that would fulfill most of the remote area quartering needs for personnel sustenance during oil spill response. However, the shelters identified were judged to be deficient

for one or more of the following reasons:

- Not properly packaged for air transport by HC-130
- Not adaptable to all types of terrain
- Not suited for the range of climatic extremes found in Alaska
- Lack of field tests
- Excessive assembly time and/or skill required for erection
- Not a completely contained unit (i.e., utilities and power not included)
- Not suited for reuse over periods of many years
- Too expensive
- Too bulky or heavy to unload at staging area without heavy equipment

Portable or semi-portable shelters that have been used in polar regions since the 1940's include the World War II Jamesway, the Atwell, the Quonset rigid frame, the Clements and the T-5 (used by the Coast Guard).[2,3] Modern materials and technology offer the chance for significant improvements in weight reduction, durability and thermal efficiency in construction of portable shelters. Major innovations such as laminated panels for combined strength and insulation, stressed-skin structures and expandable accordion type configurations are generally not past the advanced development stage. Arctic field testing and reuse under operating conditions have yet to be accomplished. Physical properties of typical shelter construction materials are shown in Table 4-24.[4]

TABLE 4-24

PHYSICAL PROPERTIES OF SHELTER CONSTRUCTION MATERIALS

Material	Ultimate Tensile Strength (psi)	Density (lbs/cu ft)	Modulus of Elasticity (psi)	Thermal Conductivity (Btu/hr-ft-°F)
Fiberglass (spray up mat)	20,000	90.0	$1x10^6$	0.12
Fiberglass insulation	0	1.1	0	0.02
Polyurethane				
Low density foam	50	2.2	-	0.02
Medium density foam	200	6.0	-	0.02
Elastomer	15,000*	70.0	-	Low**
Polystyrene	90	2.5	-	0.02
Wood (Douglas Fir)	11,000*	34.0	$1.6x10^6$	0.06
Steel (low carbon	60,000	490.0	$30x10^6$	26.0
Aluminum (6061-T6)	38,000	163.0	$10x10^6$	118.0

*Flexure strength

**Exact value not available

A survey by the University of Cincinnati for the Air Force on advanced concepts for lightweight portable shelters concluded that the C-130 aircraft and the 463L pallets and handling equipment were the most likely to be used in the deployment of air mobility structures.[1] The same study included a summary of design requirements for portable shelters (Table 4-25) that was extracted from twelve source documents pertaining to military shelters.

Portable shelters available are of several general types:[5]

- Non-rigid, frame supported (tents)
- Rigid-expandable (accordion type)
- Rigid, non-expandable
- Inflatable
- Rigid arch
- Inflatable rib arch

Most types can be used without a foundation at least temporarily in the Arctic and sub-Arctic. However, problems with drifting snow blocking entrances and the melting of snow or permafrost beneath the structure over a period of weeks or months makes piles or some other type of elevated foundation desirable for extended use. The shelters are generally supported by either skids (which also serve as mud sills) or adjustable legs with pads. Heavy shelters mounted on steel skids to permit relocation can be troublesome in that the building becomes buried in hard snow drifts and even the most powerful equipment has trouble moving it.[6]

TABLE 4-25

PORTABLE SHELTER

DESIGN REQUIREMENTS MATRIX

General Design Requirements and Goals	Selected Requirements To Guide Design Work
Volume Ratio : Erected to Shipping	6:1 Minimum 12:1 Goal
Maximum Volume Per Package	Compatible with C-130 and 463L
Maximum Weight Per Packaged Shelter	Pallet Load or Equivalent Up to 8,000 Pounds
Normal Transport	Normal 463L and Air Cargo Stresses
Air Drop	Not Practical Within Weight and Other Goals
Minimum Shelf Life	10 Years
Minimum Operational	5 Years
Minimum Erection Cycles	20 Cycles
Fire Resistance:	Fire Resistant
Maximum Thermal Conductivity (Rigid Surfaces)	0.25 BTU/Hr/Sq Ft/°F at 70°F Temp Difference
Maximum Thermal Conductivity (Flexible Surfaces)	0.42 BTU/Hr/Sq Ft/°F Maximum
Ventilation	30 CFM Per Person
Heating	68°F Dry Bulb
Cooling	Maintain 75°F Interior Temperature
Lighting	100 Footcandles
Safety	Minimize Hazards
Transmitted Noise Attenuation	30 db Average
Noise Attenuation Range	75-10,000 Hz
Other Factors	5' Partitions
Wall and Ceiling Materials	Al or FRP with Urethane, Styrene, or Paper Honeycomb Core

TABLE 4.25 (Continued)

Anchoring	Arrowhead Anchors
Electrical Supply	100 amp, 60 Hz, 10 Dual Receptacles
Process Piping	Consider In Design
Plumbing	Consider In Design
Number of Doors	2
Door Size	36"W x 84"H Minimum
Number of Windows	Maximum Consistent with Structure Limits
Emergency Exits	1 Minimum
Screens	Required
Time for Erection	20 Manhours Maximum with 5 Man Crew
Tools	Hand Tools and Manual Gantry
Goal For Production Greater Than 500	$10 Per Square Foot of Floor Area
Leveling	Integral Jacks
Over Land Movement	Only Packaged and on Carrier
Slope of Site	One Foot Rise in 35 Feet
Wind Loads	100 mph with 130 mph Gusts
Operating Range	World Wide - 40° to +125°F
Flooring	Al or PRP With Urethane, Styrene, Paper Honeycomb or Al Honeycomb Core
Floor Loading	75 PSF Minimum
Foundation	Difficult Site Accommodation
Roof Loading	30 PSF Ice and 40 PSF Snow Element

Military programs to develop improved portable personnel shelter systems include:[7]

Air Force

Bare Base Expandable Personnel Shelter (BBEPS) which is a part of a larger Bare Base Mobility Program

Navy

Tactical Container Shelter System (TACOSS)

Army

Air Transportable Total Building System (ATTBS)

The Canadian Army has developed a portable shelter used extensively in the Arctic called the Wannegan. The shelter is 15 feet long, 7 feet wide and 7 feet high.[8] The packaged shelter weighs approximately 2,000 pounds and is 15 feet by 7 feet by 2-1/2 feet. The shelter rides on either skids or skis[9] when being towed. Equipment includes 110-volt and 24-volt lighting systems, batteries and battery charger, and heating and ventilating systems. Double entrance doors are located at one end and an emergency escape hatch is in the roof.

The use of snow for shelters (i.e., an Igloo or snow house) is possible with the right conditions of snow, enough time and the proper skills. There are three broad ways in which snow can be utilized as a structural material.[10]

- Use in place to form pads and pavements or walls and roofs of excavations
- Cut into blocks and building like masonry
- Pulverized mechanically and cast like concrete

The use of snow shelters cannot be recommended for any type of quartering during oil spill response operations, except as a means for survival.

Two types of expandable shelters were field tested by the USARAL at Fort Greely, Alaska between December of 1973 and April of 1974. The shelters tested were a modified accordion type structure originally designed for the Air Force Bare Ba: Program (12:1 expansion ratio) and a rigid structure similar in appearance to the T-5 (3:1 expansion ratio). Both shelters were found to provide protection superior to any Army tentage or other tactically employable shelters presently used in Alaska.[11] Heaters used in both shelters were Herman-Nelson ducted, forced-air design intended for use with Bare Base shelters. The expandable shelter had a floor area of approximately 280 square feet. The shelters were found to be generally adequate with respect to transportability, heating and habitability in temperatures to -52°F. However, many minor shortcomings and deficiencies were found in construction, erection and maintenance requirements, and safety that would preclude effective use during emergency response operations. The need to correct many deficiencies and shortcomings were clearly indicated. The 400 square foot expandable shelter was adequate for billeting up to eight personnel under austere garrison conditions and up to 15 personnel under field conditions.[11] Descriptions of the two shalters appear in Appendix B (EXP and ES/c).

Portable sled-mounted rigid shelters with tent extensions have recently been developed for seismic work in the Canadian Arctic.[12] Each unit is totally self-contained and will support four men for 14 days. The units ride on aluminum sleigh runners designed on the Eskimo Komotik principle and are drawn by 35 hp All Terrain Vehicles

(modified Playcats). Loaded weight is less than 600 pounds and the units are designed for DC-3 transport. The units have been successfully tested over rough pack ice.

Portable shelters for use in oil spill response operations must be completely self-contained, durable, and easily and rapidly erectible in the field to avoid diverting personnel from oil cleanup efforts or other purposes. Shelters intended for billeting should have bunks and latrine facilities; those intended for mess halls should have all of the required cooking equipment and utensils when they arrive at the site. A selected summary of typical military portable shelters designed for various field functions appears in Appendix B. The shelter descriptions were extracted from the Reference Manual on Shelters prepared by the U.S. Army Nattick Laboratories.[5]

4.5.2 Provisioning

Hot nourishing meals will probably be required to maintain the morale of field personnel for extended periods during oil spill response operations. Military "C"-rations or cold rations will suffice only a few days, at most. The caloric requirements for working in cold climates are only slightly higher than those in temperate climates. Because good food is a paramount morale factor, the Navy increases the ration by about 50% within the polar circles. Shipboard living calls for merely increase in the amount of balanced diet; however, life on the ice or onshore, which is colder and more strenuous, calls for increased protein to rebuild muscle and glandular tissues, and for a diet higher in fat content, and for increased vitamins or vitamin-containing foods.[3] The cold weather diet recommended in the Navy Polar Manual is compared to an average temperate diet in Figure 4-26.

TABLE 4-26

RECOMMENDED COLD WEATHER DIET

Food Element	Temperate	Cold Weather
Carbohydrates (4.1 cal/gm)	53%	40%
Fats (9.3 cal/gm)	35%	40%
Protein (4.1 cal/gm)	12%	20%
First-class Proteins (Meat, Milk, Eggs)	40% of 12% above	50% of 20% above
Total Calories	3500	5000-5500

Prepackaged dinners (similar to T-V dinners) that are vacuum packed in plastic provide a great variety of choices and can be thawed and refrozen several times with no ill effects.[12] The meal requires only heating in a portable oven before serving. Food for personnel working temporarily in areas away from the messing facilities could be the standard rations developed for survival or trail operations. True pemmican is the lightest, most complete, and the most satisfying single food for trail operations.[3]

Water for drinking and other uses must be available at the staging area. When on maneuvers in cold regions, men have never suffered from thirst even in the coldest conditions, but their water may have been of poor quality or scanty at times.[13] Eating ice or snow for a period of one or two days will result in a swollen, raw mucous membrane in the mouth which may be very painful.[3] Chlorination or boiling of onshore surface water in the Arctic is mandatory. A man should drink between two quarts and one gallon of water per day.[3,13] An additional two to five gallons per man per day may be require for other purposes such as cooking and bathing.

4.5.3 Clothing and Survival Gear

Working around oil spills can result in very smelly and unpleasant outer clothing every day. A few extra pairs of discardable coveralls and several extra sets of gloves can alleviate these unpleasant working conditions. The type of protective clothing required for field operations in Alaska varies by area and season. Proper gear for dry and cold Arctic operations are adequately described in the Navy Polar Manual and many other sources. The sub-Arctic coastal regions of Alaska normally require protective outer clothing more suited to very wet and windy conditions. Proper foot protection is an absolute essential and the types required vary with area and season.

Survival gear should be worn or carried by each person arriving at the scene. The protective clothing and survival gear for working in all climates issued to personnel of the Pacific Strike Team is summarized below:[14]

Item	Units
Helmet	1 each
Liner, Helmet	1 each
Jacket, Foul Weather	1 each
Jacket, Oil Resistant	1 each
Coveralls, w/Lettering	3 pair
Exposure Suit, complete with Boots, Gloves, Hood	1 each
#146 Antarctic Suit	1 set
#80 Insulated Underwear	1 set
Rain Suit	1 each
Gloves, Wool	1 pair
Gloves, Leather	1 pair
Gloves, Work, Leather	1 pair
Boots, Flight	1 pair
Boots, Arctic	1 pair
Face Cap	1 each
Hood, Winter, Flying	1 each
Duffel Bag	1 each

Flight Bag	1 each
Mess Kit	1 each
Knife	1 each
Fork	1 each
Spoon	1 each
Canteen	2 each
Canteen Cover	2 each
Drinking Cup	1 each
Belt	1 each
Vest, Survival	1 each
First Aid Kit	1 each
Snake Bite Kit	1 each
Knife, Survival	1 each
Knife, Survival, Sw/Blade	1 each
Mirror, Signal	1 each
Compass, w/Case	1 each
Whistle	1 each
Flashlight, Explosion Proof	1 each
Marker Light, Distress w/Battery	1 each
Dye Marker, Sea	1 each
Sunglasses	1 pair
Blanket, Emergency	1 each

Alaska law required the following minimum items for cross-country flying during the summer:(15)

- Food for each occupant sufficient to sustain life for two weeks
- One ax or hatchet
- One first-aid kit
- One pistol, revolver, shotgun, or rifle, and ammunition for same
- One small fish net and an assortment of tackle, such as hooks, flies, lines, sinkers, etc.
- One knife
- Two small boxes of matches

- One mosquito headnet for each occupant
- Two small signaling devices, such as colored smoke bombs, railroad fuses, or Very pistol shells in sealed metal containers
- Emergency locator beacon

The following additional (minimum) items are required from October 15 to April 1:

- One pair of snowshoes
- One sleeping bag
- One wool blanket for each occupant over four

More detailed information on flying within Alaska is available at all Federal Aviation Administration border stations.

A high-power firearm of some type is highly desirable for Alaskan field operations for reasons other than survival. Bears and certain smaller animals can become a real nuisance, or, in extreme cases, dangerous to field personnel. Firearms are the best means to avoid or cure potential problems. Protection from insects is mandatory during the summer in virtually all areas of the Arctic and sub-Arctic. Headnets, gloves, tight-sleeved shirts tucked in trousers, mosquito nets and the application of spray help the nuisance.[3]

4.5.4 Medical Services

Cold-related injuries can potentially happen anywhere within Alaska during the winter and in the Arctic regions at any time. The primary types of cold injury are:[3,16]

- Chilblains
- Frostbite
- Immersion Foot

- Freezing
- General Hypothermia (including immersion hypothermia)

Serious cases of cold injury or injuries resulting from accidents will require evacuation to the nearest suitable hospital, probably by helicopter. It is assumed that limited medical assistance in the field can be provided by a member of the oil spill response team who is a medic or at least trained in first aid. Ship's medical services would also be available for most marine spills. Air ambulance or paramedic assistance is available from either units of the Alaska Command or private industry in Anchorage. The Air Force has the capability to provide parame s by parachute.

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5.0 LOGISTIC SYSTEM REQUIREMENTS FOR SELECTED ARCTIC AND SUB-ARCTIC LOCATIONS

Logistic response requirements for oil spills at selected sites throughout Alaska are based on the following guideline information originally provided by the Coast Guard:

Environmental Description	Spill Area/Volume	Manpower Required	Days On Scene	Equipt Vol/Wt	Response Time (Hours)
Moving Pack Ice	52,000 ft^2 / 100,000 gals	20	20	1,000 ft^3 / 35,000 lbs	24
Open Water	.15 sq. miles / 100,000 gals	25	10	"	10
Shorefast Ice	.03 sq. miles / 100,000 gals	15	15	"	24
Tundra	"	15	15	"	24

The succeeding evaluation of present and required logistic support capability is based on the following assumptions:

1. The response period begins with a call for assistance from the On-Scene Coordinator and ends when all personnel are present and the equipment is unloaded and ready to use at the spill scene.

2. The equipment required for oil spill response (35,000 lbs) is specialized and, therefore, must originate from a preselected supply base.

3. The supply base is located either at Kodiak Coast Guard Base or Elmendorf Air Force Base in Anchorage (oil containment equipment for response throughout Alaska is presently at Elmendorf).

4. The delivery of equipment is a more critical aspect of primary transportation than delivery of personnel (i.e., personnel can be transported to the site by a combination of modes that will not accommodate the entire equipment load).

5. Vessels and aircraft are available at the supply base for departure within two hours of notification and the personnel and equipment can be loaded for primary transport within the same two-hour period.

6. Equipment can be unloaded and prepared for use at the site within two hours.

7. Air drop capability does not presently exist for the 35,000 pounds of equipment required.

8. Weather and/or airport conditions are not factors in response time (this assumption is necessary because the delay due to either cannot be calculated).

9. Aircraft (helicopter) refuelling requires one hour and an adequate number of pilots are available to fly shifts on ferry operations if required.

10. The entire 35,000 lbs of equipment will fit into an HC-130.

11. Calculation of response time to spills during spring breakup in the Arctic (two-three weeks) is meaningless and, therefore, only summer and winter conditions need evaluation.

12. The number of icebreakers in the Arctic at any time is insufficient for consideration as a means of primary transportation.

13. Both offshore and onshore oil spills are within a 20 mile radius of the specific location selected for evaluation.

The fourteen sites selected for logistic support evaluation are:

Offshore Yakutat	Offshore Nome
Valdez Narrows	Offshore Cape Blossom
Offshore Port Graham	Offshore Prudhoe Bay
Drift River Terminal	Onshore Prudhoe Bay
Unimak Pass	Umiat
Offshore Port Moller	Yukon River TAPS Crossing
Kvichak Bay	Denali Fault TAPS Crossing

These representative sites are located in areas which were identified in a prior study by Battelle-Northwest for the Coast Guard(1) as having relatively high potential for oil spills. The potential for oil spills was based primarily on projected production and transportation of crude oil in the areas during the next two decades. The specific sites selected are further felt to be representative of the range of physiographic and environmental conditions in which future oil spill response operations will be conducted. Southeast Alaska and the outer Aleutian Island locations were not included in the site selection because prospects for future crude oil production in these areas are not significant. Logistic support capability and requirements for Southeast Alaska locations are felt to be as adequate as those for other areas a similar distance from the supply bases.

The assumptions made above for evaluation of present capability and the requirements for response to the selected sites in some cases may be overly optimistic or require a level of preparedness that does not presently exist in Alaska. The importance of preparedness cannot be overemphasized and it is, therefore, reasonable to expect that most of the necessary preconditions will be established in Alaska within the next few years.

5.1 PHYSIOGRAPHY AND SEASONAL ENVIRONMENTAL CONDITIONS

This section covers the climatic, oceanographic and other geophysical conditions to be encountered as a consequence of oil spill logistic operations in Alaska. It is, in general, an extension of the information contained in Report No. CG-D-79-74.[2] The discussion is divided into three parts for each spill site:

- a general summary of local weather
- offshore sea conditions and weather
- local flying weather conditions

Part 1, the local weather conditions, includes meteorological variables that are important in logistic operations, such as temperature, precipitation, winds, cloudiness, and fog. This information is usually summarized from NOAA Local Climatological Data. At sites where official weather data are limited or not available, data from the nearest representative observing station is used.

Part 2, offshore sea and marine weather conditions farther from the coastal regions, is compiled from data obtained from the U.S. Navy "Summary of Synoptic Meteorological Observations - North American Coastal Marine Areas." This information includes sea temperature, sea heights, fog and other meteorological conditions. These data are probably biased toward good weather statistics since ships tend to avoid the worst weather and sea conditions. Local tidal and sea ice information is also included in Part 2. This data is not included for the three land spill sites, Umiat, Yukon River Taps Crossing and Denali Fault Taps Crossing.

Local flying weather data, Part 3, is summarized principally from the U.S. Naval Weather Service "World-Wide Airfield Summaries"[3] and gives abbreviated information on the frequency

of occurrence of certain specified cloud ceilings and horizontal visibilities for the local sites. Enroute weather conditions, i.e. cloud cover, heights and tops of clouds, visibility, turbulence, freezing altitude, icing and winds from staging base to spill site, are all important parameters for flight planning. However, since this type of information is usually only available on a day-to-day basis and not in summarized form, no attempt was made to include this type of information in the report. A daily weather briefing from a Weather Service office will provide current enroute weather for flight planning.

5.1.1 Offshore Yakutat

Local Yakutat Weather

The Yakutat area is surrounded on three sides by the waters of the Gulf of Alaska and Yakutat Bay; consequently, the climate is maritime in character. Although the area in the immediate vicinity is relatively flat, rather rough, hilly terrain exists within short distances. Approximately 40 to 75 miles to the north and northwest peaks of the St. Elias Range rise to heights of 14,000 and about 20,000 feet. Table 5-1 presents normals, means, and extremes for Yakutat.

Temperatures

Normal monthly temperatures range from slightly above 26°F in January to around 53°F in July and August. Although Yakutat has experienced a record low of -24°F, readings near this number are rare. Yakutat averages about 20 days each year with temperatures below zero. Higher terrain to the north, with extensive glaciation, is favorable for down-slope cold air drainage which results in wide variations of temperature within short distances. Maximum temperatures above 80-85°F have occurred in June, July and August.

TABLE 5-1

NORMALS, MEANS AND EXTREMES FOR YAKUTAT

Month	Temperature: Normal: Daily maximum	Daily minimum	Monthly	Extremes @: Record highest	Year	Record lowest	Year	Normal heating degree days (Base 65°)	Precipitation: Water equivalent: Normal	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs	Year
(a)	(b)	(b)	(b)	@		@		(b)	(b)	31		34		26	
J	34.4	20.2	27.3	45	1965	-21	1965	1169	10.86	23.98	1949	1.59	1950	5.11	1962
F	35.0	21.4	28.6	47	1968	-20	1969	1019	8.20	32.13	1964	2.42	1962	4.99	1964
M	39.8	23.0	31.4	50	1970	-20	1972	1042	8.69	18.86	1947	2.06	1958	5.28	1965
A	44.6	29.4	37.0	58	1965	5	1972	840	7.23	12.93	1964	0.75	1948	3.93	1966
M	52.2	37.0	44.6	74	1969	21	1972	632	7.98	18.95	1965	2.73	1960	4.96	1965
J	57.6	43.3	50.5	78	1969	29	1971	435	5.06	16.24	1965	0.52	1946	4.62	1964
J	60.5	47.7	54.1	83	1971+	35	1968	338	8.43	21.49	1959	1.70	1957	5.36	1959
A	60.6	47.0	53.8	77	1968	30	1969	347	10.92	23.89	1942	2.05	1954	5.56	1965
S	56.7	41.7	49.2	69	1967	21	1971	474	16.55	27.10	1943	3.04	1946	6.38	1960
O	48.9	34.8	41.9	63	1967	6	1966	716	19.59	36.89	1965	6.68	1950	6.97	1963
N	40.9	26.7	33.8	54	1970	-6	1966	936	16.03	43.88	1956	4.36	1950	7.13	1956
D	34.2	22.0	28.1	51	1969	-24	1964	1144	12.27	28.54	1943	4.58	1942	6.10	1963
YR	47.2	32.9	40.0	83	JUL. 1971+	-24	DEC. 1964	9092	131.01	43.88	NOV. 1956	0.52	JUN. 1946	7.13	NOV. 1956

Month	Snow, Ice pellets	Relative humidity	Wind &	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Mean number of days	Average daily solar radiation - langleys
J–YR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

@ For period September 1964 through the current year.
Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows:
Highest temperature 86 in August 1957.

(a) Length of record, years, based on January data. [illegible]
(b) [illegible] normals (1931-1960).
* [illegible]
\+ [illegible]
T [illegible]
[illegible]
‡ [illegible]

Unless otherwise indicated, dimensional units used in this bulletin are: temperature in degrees F.; precipitation, including snowfall, in inches; wind movement in miles per hour, and relative humidity in percent. Heating degree day totals are the sums of negative departures of average daily temperatures from 65° F. Cooling degree day totals are the sums of positive departures of average daily temperatures from 65° F. Sleet was included in snowfall totals beginning with July 1948. The term "Ice pellets" includes solid grains of ice (sleet) and particles consisting of snow pellets encased in a thin layer of ice. Heavy fog reduces visibility to 1/4 mile or less.

Sky cover is expressed in a range of 0 for no clouds or obscuring phenomena to 10 for complete sky cover. The number of clear days is based on average cloudiness 0-3, partly cloudy days 4-7, and cloudy days 8-10 tenths.

Solar radiation data are the averages of direct and diffuse radiation on a horizontal surface. The langley denotes one gram calorie per square centimeter.

& Figures instead of letters in a direction column indicate direction in tens of degrees from true North; i.e., 09 - East, 18 - South, 27 - West, 36 - North, and 00 - Calm. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. If figures appear in the direction column under "Fastest mile" the corresponding speeds are fastest observed 1-minute values.

Source: Environmental Data Service (NOAA)

Precipitation

The up-slope terrain, combined with frequent storms and moisture-laden air, tends to provide Yakutat with abundant rainfall. The annual precipitation of about 130 in. is one of the greatest in the state, and annual amounts have always been in excess of 85 in. October, with an average of almost 20 in., has the heaviest monthly rainfall and June has the least (∿5 in.)

Snowfall has occurred in all months of the year except June, July, and August. The heaviest fall in any 24-hr period was 32 in.

Winds

During the spring, fall and winter months the Yakutat area is subjected to numerous cyclonic storms, usually accompanied by high winds. Wind directions during strong winds are east and east-southeast and maximum speeds vary from 30 to 65 knots.

The St. Elias Mountain range and surrounding glaciers exert a pronounced effect upon the local weather, particularly when a steep pressure gradient develops with low pressure in the Gulf of Alaska. Under these conditions, cold and gusty down-slope winds may occur.

Cloudiness and Fog

Cloudiness is abundant with the annual average sunrise to sunset mean sky cover ranging from six to nine-tenths.

Heavy fog (visibility less than one-fourth mile) varies in the mean from one to five days a month. Maximum frequency is during the summer months.

Offshore Sea Conditions and Marine Weather

Local Sea and Ice Conditions

Tides The mean tidal and diurnal ranges for Yakutat and Yakutat Bay are 7.8 and 10.1 ft, respectively. The mean range is defined as the difference in height between mean water and mean low water. The diurnal range is the difference in height between mean higher high water and mean lower low water.

Ice Icebergs in Yakutat Bay come from the glaciers at the head of Disenchantment Bay and from Nunatak Glacier, at the head of Nunatak Fiord. Scattered bergs usually are found in the bay proper, and occasional drifts find their way as far south as Ocean Cape and Point Manby.(4)

Data for offshore sea conditions may be obtained from SSMO Volume 11 or 12. The following information was summarized from Volume 12 (Cordova).(5)

Sea Temperatures

During the winter months offshore water temperatures are normally 40-45°F but may vary (long-term) from 33°F to 50°F. During the summer months temperatures are normally 55-60°F but may vary from 45-65°F.

Sea Heights

The normal sea height is 3 to 6 ft but with wind speeds above 30 knots, wave heights may reach 25 ft or more. Wave heights greater than 15 ft are usually associated with winds from the southeast or southwest quadrants.

Fog

Fog occurs during all months with maximum frequency (5-10%) during May, June, July, and August and minimum frequency (1-3%) during September, October, and November.

Local Flying Weather

Generally, 20 to 27 days a month have favorable local flying weather (Table 5-2). Strong winds, which are not factored into the statistics, may decrease these days by 5 to 10%. Flying conditions are more unfavorable during the winter and summer periods (because of fog), with more favorable conditions during the months of April, May, October, and November.

TABLE 5-2

YAKUTAT - FLYING WEATHER

Average Frequency (%) When Ceiling ≤ 300 Ft and Visibility ≤ 1 Mi

Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
6.6	8.8	8.5	2.3	2.8	5.9	4.3	9.8	9.9	2.5	1.7	6.3

Mean Number of Days Ceiling ≥ 1,000 Ft and Visibility ≥ 3 Mi

Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
24	22	24	27	27	24	24	20	21	26	25	23

5.1.2 Valdez Narrows

Local Valdez Weather

Valdez is located on the Valdez Arm, a rather well-sheltered extension of Prince William Sound. Snow-capped mountains, containing extensive glacier areas, extend almost continuously from southeast of Valdez through north to west-southwest, with rugged but normally unglaciated mountains to the south and southwest. Active glaciers extend to within 5 to 10 miles of

Valdez to the north and reach down to the level of the glacial plain on which Valdez is located. The terrain surrounding Valdez exerts a pronounced influence on practically all aspects of the local weather and climate. The climate is basically maritime. Table 5-3 presents means and extreme data for Valdez.

Temperatures

Normal monthly temperatures range from 19°F in January to 53°F in July and August. Although the high mountain ridges to the north provide a barrier to the flow of cold continental air from the interior during the winter months, this is offset by the cold downslope drainage from the glacier areas. Valdez averages about 13 days each year with temperatures below zero. The record low has been -28°F. In the summer, nearby snow and ice fields combine with the ocean areas to moderate the maximum temperature. The record high has been 84°F in July and August.

Precipitation

Precipitation is abundant the year around, but increases noticeably during August, September, and October when over one-third of the total annual rainfall (∿62 in) occurs. May and June are the driest months (∿6 in).

Snowfall during the winter months is very heavy. The mean annual total is around 249 in. and the maximum in 24 hrs has been about 43 in. Large variations in both rain and snow occur within short distances because of elevation differences in terrain.

Winds

The sheltering effects of surrounding mountains channel local winds into two distinct prevailing directions. From

TABLE 5-3

MEANS AND EXTREMES FOR VALDEZ

	TEMPERATURE (°F)								PRECIPITATION (In.)														WIND	MEAN NUMBER OF DAYS					
	MEANS			EXTREMES												SNOW, SLEET, HAIL									Max temp		Min temp		
Month	Daily maximum	Daily minimum	Monthly	Record highest	Year	Record lowest	Year	Mean degree days	Mean total	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hours	Year	Mean total	Maximum monthly	Year	Maximum in 24 hours	Year	Max. depth on ground	Year	Prevailing direction	Precip .01 or more	70° or abve.	32° or blw	32° or blw	0° or blw	Month
(a)	39	39	34	34		38		38	38	38		38		38		34	34		34		34		33	39	30	32	38	40	(a)
JAN	25.9	11.7	16.8	50	1916	-24	1951	1432	8.08	15.17	1949	0.41	1914	3.04	1949	80.6	127.8	1949	32.5	1948	115	1924	NE	12	0	23	31	9	JAN
FEB	29.9	13.6	21.3	59	1923	-28	1947	1224	4.62	14.24	1928	0.23	1950	4.00	1928	47.4	174.5	1928	43.0	1928	120	1921	NE	11	0	17	26	1	FEB
MAR	34.1	17.3	25.7	52	1911	-11	1918	1218	4.03	13.55	1930	0.40	1932+	2.75	1931+	36.5	117.1	1930	25.0	1927	132	1929	NE	11	0	10	31	1	MAR
APR	42.9	27.3	35.1	63	1910	4	1910	897	2.91	10.11	1941	T	1948	2.36	1915	12.0	114.6	1918	17.0	1930	135	1929	NE	11	0	2	27	0	APR
MAY	51.2	33.9	42.6	79	1910	13	1945	694	2.90	5.90	1916	0.33	1923	1.80	1936	2.8	22.0	1949	12.0	1949	40	1919	SW	14	*	0	10	0	MAY
JUN	58.4	41.4	49.9	83	1936	28	1941	453	2.39	5.90	1950	0.46	1934	1.66	1914	0.0	0.0		0.0		2	1939	SW	13	1	0	*	6	JUN
JUL	60.4	45.1	52.8	84	1911	33	1942	378	3.82	8.28	1952	0.88	1916	2.41	1930	T	T	1939	T	1939	0		SW	16	2	0	*	0	JUL
AUG	59.9	43.7	51.8	81	1911	29	1913	409	6.27	17.41	1932	1.07	1911	2.97	1932	0.0	0.0		0.0		0		SW	19	1	0	*	0	AUG
SEP	53.3	38.6	46.1	82	1910	14	1946	567	9.21	18.74	1912	1.23	1922	3.71	1949	0.1	2.0	1928	2.0	1928	0		SW	19	*	0	4	0	SEP
OCT	43.7	31.6	37.7	69	1921	[illegible]	[illegible]	818	7.96	17.23	1936	2.22	1947	2.65	1945	8.0	27.4	1939	16.1	1939	11	1950	NE	18	0	1	17	0	OCT
NOV	32.6	20.6	26.6	59	1936	[illegible]	[illegible]	1152	5.85	17.39	1952	0.32	1909	3.20	1951	31.5	110.3	1930	22.0	1941	39+	1925	NE	13	0	12	29	0	NOV
DEC	26.4	13.6	20.2	[illegible]	1929	[illegible]	[illegible]	1399	5.65	16.66	1928	0.14	1917	3.55	1928	49.8	150.8	1928	29.0	1921	74	1930	NE	13	0	22	31	2	DEC
Year	43.2	24.2	33.7	84	Aug 1911	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Sep 1912	T	Apr 1948	4.00	Feb 1928	248.7	174.5	Feb 1928	43.0	Feb 1928	135	Apr 1929	NE	170	4	87	208	13	Year

(a) Average length of record, years. * Less than one half. + Also on later dates, months or year. T Trace, an amount too small to measure.

Source: Environmental Data Service (NOAA)

October through April all prevailing directions are northeast; from May through September prevailing directions are from the southwest. Surface winds are between 0-3 knots about 59% of the time. Surface winds in any mountainous terrain are variable and at times destructive. The most critical area in this respect is the Valdez Arm, where several valleys lead into the Arm. This type of topographic configuration quite often funnels the air, increasing its speed, until wind gusts between 80-85 knots are occasionally observed in the winter time. During summer, wind gusts of 50-55 knots may be encountered.

Cloudiness and Fog

There is considerable cloudiness during the entire year, but slightly less than is encountered at Alaskan sites farther southeast. About one day in six can be classified as clear (zero to three-tenths cloudiness). Data are not available on the frequency of fog.

Offshore Sea Conditions and Marine Weather

Local Sea and Ice Conditions

Tides The mean tidal and diurnal ranges for the Valdez area are around 9.6 and 12.1 ft, respectively. The tidal current is about 0.5 knot and is usually too weak and variable to be predictable.[4]

Ice Glacial ice is rarely found in the open waters of Prince William Sound, the entrance to the Valdez Arm. Ice is discharged by several glaciers but rarely reaches the main part of the sound. During very cold weather ice sometimes forms in the arms of the sound which reach well into the mountains and is, at times, heavy enough to impede navigation.[4]

Data for offshore sea conditions (Prince William Sound and oceanward) may be obtained from SSMO Volume 12. The following information was extracted from Volume 12 (Seward).[6]

Sea Temperatures

During the winter months offshore water temperatures are normally 40-43°F but may vary from 33-48°F. During the summer months, temperatures are normally 54-56°F but may vary from 43-66°F.

Sea Heights

Normal sea heights are between 1-5 ft and on rare occasions with winds above 50 knots wave heights have been observed up to about 32 ft.

Fog

Fog occurs during all months with maximum frequency (10-13.3%) during June, July, and August and minimum frequency (0.7-1.8%) during October, November, and December.

Local Flying Weather

Flight weather data are not available for Valdez. Alyeska Pipeline Service Company[7] indicates that due to terrain limitations an instrument approach with realistic minimums is not practical at Valdez. Furthermore, it is stated that their operations to and from Valdez must be in VFR conditions.

The nearest observation station with flight weather data is Cordova. The data are given in Table 5-4 as a general guide to flying conditions; however, Cordova's data may not be totally representative of Valdez due to terrain and exposure.

TABLE 5-4

CORDOVA - FLYING WEATHER

Average Frequency (%) When Ceiling $\leq$ 300 Ft and Visibility $\leq$ 1 Mi

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
3.8	4.1	2.7	2.3	0.6	1.1	1.5	1.6	0.7	0.4	0.8	3.1

Mean Number of Days Ceiling $\geq$ 1,000 Ft and Visibility $\geq$ 3 Mi

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
28.0	24.5	28.4	27.3	29.6	27.4	26.4	27.3	27.6	29.8	28.2	27.8

5.1.3 Offshore Port Graham

Local Port Graham (Homer) Weather

The nearest official weather observation station to Port Graham is Homer, although unofficial and incomplete records exist for Seldovia. The more complete records of Homer will be the primary data base in the following presentation.

Port Graham, a secure harbor, is located in the southern end of the Kenai peninsula and as a consequence the climate is more maritime than locations further north. Extremes and means for Homer are presented in Table 5-5.

Temperature

Normal monthly temperatures for Port Graham range from the 20s in January to the 50s in July and August. Record

TABLE 5-5

NORMALS, MEANS, AND EXTREMES FOR HOMER (PORT GRAHAM)

Month	Temperature c: Normal ∅ Daily maximum	Normal ∅ Daily minimum	Normal ∅ Monthly	Extremes: Record highest	Year	Record lowest	Year	Mean heating degree days, 1943-1967.	Precipitation c: Normal total	Maximum monthly	Year	Minimum monthly	Year	$ Maximum in 24 hrs.	Year
(a)	(b)	(b)	(b)	29		29		25	(b)	37		37		37	
J				51	1961	-17	1947+	1345	2.05	4.85	1945	0.39	1969	1.74	1940
F				51	1954	-18	1947	1145	1.44	5.25	1941	0.16	1950	1.68	1941
M				50	1944	-21	1971	1181	1.38	3.87	1941	0.21	1953	1.24	1968
A				63	1965	-9	1944	909	1.30	3.49	1959	0.01	1954	1.44	1950
M				69	1964	6	1949	713	1.07	2.04	1953	0.16	1951	0.81	1943
J				80	1953	29	1950+	492	1.05	3.37	1941	0.09	1957	1.19	1949
J				78	1967	34	1959+	391	1.76	3.79	1948	0.16	1953	1.32	1948
A				78	1944	31	1955	394	2.82	5.56	1939	0.52	1962	1.80	1936
S				68	1965+	20	1956	540	2.76	5.30	1961	0.83	1969	1.43	1957
O				64	1954	7	1966	862	3.51	8.55	1969	0.91	1933	2.24	1946
N				52	1962	-7	1963	1104	2.70	8.59	1952	0.12	1955	3.02	1952
D				50	1969	-16	1964	1345	2.63	8.01	1939	0.00	1933	1.93	1931
YR				80	JUN. 1953	-21	MAR. 1971	10421	24.47	8.59	NOV. 1952	0.00	DEC. 1933	3.02	NOV. 1952

Month	Snow, Ice pellets: Mean total	Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity: Hour 02 (Local time)	Hour 08	Hour 14	Hour 20	Wind &: % Mean speed	Prevailing direction	Fastest mile: Speed	Direction	Year	Pct. of possible sunshine	Mean sky cover sunrise to sunset	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	† Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	# Thunderstorms	# Heavy fog	Temperatures Max. ‡ 90° and above	Max. 32° and below	Min. 32° and below	Min. 0° and below	Average daily solar radiation - langleys
(a)	29	37		37		1	4	4	4	5	20					3	3	3	3	16	4	4	4	32	32	32	32	
J	10.4	33.8	1962	24.0	1939	64	72	68	71	7.2	NE					4.9	15	4	12	12	2	0	1	0	19	30	5	
F	11.7	33.6	1961	19.2	1945	83	81	74	82	7.5	NE					7.9	4	4	20	11	5	0	1	0	12	25	3	
M	9.4	32.0	1945	15.2	1954	79	79	68	75	6.9	NE					6.9	6	6	19	11	3	0	1	0	9	28	1	
A	2.9	10.8	1971	4.0	1950	85	75	66	75	6.8	NE					7.9	3	6	21	9	2	0	1	0	2	23	*	
M	0.6	6.6	1971	6.0	1971	86	74	67	76	7.0	SW					7.9	3	7	21	10	1	0	1	0	*	11	0	
J	T	T	1963	T	1963	90	74	68	74	6.5	WSW					7.8	3	6	21	9	0	0	*	*	0	1	0	
J	0.0	0.0		0.0		90	79	70	78	5.4	WSW					7.9	3	7	21	12	0	0	*	1	0	0	0	
A	0.0	0.0		0.0		91	82	71	81	5.0	WSW					7.6	4	7	20	13	0	*	2	1	0	*	0	
S	T	0.5	1962	0.4	1968	92	85	69	82	5.3	NE					7.1	6	7	17	15	0	0	1	0	0	4	0	
O	1.8	11.5	1961	6.0	1940	84	84	71	78	6.2	NE					7.1	7	4	20	16	1	0	0	0	1	19	0	
N	6.8	37.4	1945	24.5	1945	82	79	74	79	7.2	NE					6.8	7	5	18	11	2	0	2	0	11	26	*	
D	12.6	44.2	1959	14.0	1968+	79	78	77	77	6.7	NE					6.8	8	4	19	14	5	0	1	0	19	28	4	
YR	56.2	44.2	DEC. 1959	24.5	NOV. 1945	84	78	70	77	6.5	NE					7.3	69	67	229	142	21	*	8	2	72	195	13	

∅ Temperature normals have not been established for this station. Record mean values for temperature appear on the next page.

Data may be incomplete due to less than full time operation of station prior to January 9, 1971.

c Daily temperature extremes and precipitation measurements were for observational day ending about 8 P.M. until January 9, 1971. Data are for calendar day from 1-9-71.

(a) Length of record, years, based on January data. Other months may be for more or fewer years if there have been breaks in the record.
(b) Climatological standard normals (1931-1960).
* Less than one half.
\+ Also on earlier dates, months, or years.
T Trace, an amount too small to measure.
Below zero temperatures are preceded by a minus sign.
The prevailing direction for wind in the Normals, Means, and Extremes table is from records through 1963.
‡ ≥ 70° at Alaskan stations.

Unless otherwise indicated, dimensional units used in this bulletin are: temperature in degrees F.; precipitation, including snowfall, in inches; wind movement in miles per hour; and relative humidity in percent. Heating degree day totals are the sums of negative departures of average daily temperatures from 65° F. Cooling degree day totals are the sums of positive departures of average daily temperatures from 65° F. Sleet was included in snowfall totals beginning with July 1948. The term "Ice pellets" includes solid grains of ice (sleet) and particles consisting of snow pellets encased in a thin layer of ice. Heavy fog reduces visibility to 1/4 mile or less.

Sky cover is expressed in a range of 0 for no clouds or obscuring phenomena to 10 for complete sky cover. The number of clear days is based on average cloudiness 0-3, partly cloudy days 4-7, and cloudy days 8-10 tenths.

Solar radiation data are the averages of direct and diffuse radiation on a horizontal surface. The langley denotes one gram calorie per square centimeter.

& Figures instead of letters in a direction column indicate direction in tens of degrees from true North; i.e., 09 - East, 18 - South, 27 - West, 36 - North, and 00 - Calm. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. If figures appear in the direction column under "Fastest mile" the corresponding speeds are fastest observed 1-minute values.

$ For the calendar day prior to 1968, and based on 6-hourly data thereafter.

% For the period April 1950 through 1954 plus available data beginning with January 1968.

† Record for 1940-1951 and January 1968 to date.

Source: Environmental Data Service (NOAA)

lows of -21°F and -19°F have been reported at Homer and Seldovia, respectively. A maximum temperature of 80°F has also been reported at the two stations. Homer averages about 13 days a year with temperatures below zero.

Precipitation

The rain shadow of the Kenai Mountains results in annual precipitation amounts of about 14 to 35 in. with a mean around 25 in. In contrast, mean rainfall on the southeast coast is around 60 in. October has the heaviest monthly rainfall ($\sim$4 in.) and June has the least ($\sim$1 in.).

Snowfall has occurred in all months except July and August. The maximum snowfall in 24 hrs has been around 25 in. The relatively low annual snowfall is a reflection of the mild winter temperatures. Often precipitation will begin as snow but turn to rain shortly afterwards.

Winds

Wind directions in the Kachemak Bay and Cook Inlet usually prevail from the southwest during June, July, and August and from the northeast during the remainder of the year. Wind speeds at Homer are not representative of the Bay area or Cook Inlet. Seldovia records indicate mean hourly wind speeds of 10-16 knots, which are probably more typical than Homer's mean speeds of 4-7 knots. Under extreme storm conditions, winds of 75-100 knots can occur over the open water and storms with 50-75 knot winds are experienced nearly every winter.[8]

Cloudiness and Fog

Mean number of cloudy (8-10 tenths) days per month varies from 13 to 21, typical of a maritime climate.

Mean number of days per month with heavy fog is only about 1 or 2, but fog may be more prevalent over Kachemak Bay.

Offshore Sea Conditions and Marine Weather

Local Sea and Ice Conditions

Tides Mean tidal ranges are 14.4, 15.4 and 15.9 ft and diurnal ranges are 16.5, 17.8, 18.2 ft for Port Graham, Seldovia and Homer, respectively. Strong tidal currents, both ebb and flood, set across the mouth of the harbor and with opposing wind and current, heavy rip tides occur well northward and southward off the entrance to Port Graham.

Ice Ice does not generally interfere with navigation southward of Anchor Point except on the western side of Cook Inlet, where large ice fields are sometimes carried by wind and tides as far as Augustine Island.

Data for the following sea conditions and marine weather were obtained from SSMO Volume 12 (Kodiak).[9]

Sea Temperatures

During the winter months water temperatures are normally 38-41°F but may vary from 30-48°F. During the summer months temperatures are normally 49-54°F but may vary from 43-62°F. Water temperatures in winter just approach the temperature in which sea ice forms (29°F); therefore sea ice is usually not a problem at this location.

Sea Heights

Wave heights are generally around 1-4 ft but increase in height with increasing wind speed. Heights up to 25 ft have been observed with winds above 50 knots and since stronger winds have been reported from other records, wave heights must exceed 25 ft during these extreme storm periods.

Fog

Fog occurs during all months with maximum frequency (10-15%) during June, July, and August and minimum frequency (1-3%) during October, November, December, and February.

Local Flying Weather

Flight weather data are available for Homer (Table 5-6). However, these data may not be totally representative of the Port Graham area because of exposure and orographic influence of the Kenai Mountains.

Generally, flying conditions at Homer are relatively good with 26 to 30 days per month having VFR flight conditions. Flying weather is more unfavorable during December, January, and February and at intermittent periods during other months.

TABLE 5-6

HOMER - FLYING WEATHER

Average Frequency (%) When Ceiling ≤ 300 Ft and Visibility ≤ 1 Mi (based on 12 yrs of data)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1.1	1.7	0.8	1.3	0.5	0.6	0.7	1.5	0.3	0.2	0.6	1.4

Mean Number of Days Ceiling ≥ 1,000 Ft and Visibility ≥ 3 Mi (based on 12 yrs of data)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
29.3	26.2	30.0	28.7	30.6	29.6	30.4	30.1	29.6	30.5	29.0	29.0

5.1.4 Drift River Terminal

Local Weather (Kenai)

The Cook Inlet is a large tidal estuary in south-central Alaska which flows into the Gulf of Alaska. It is bordered by the Kenai Peninsula to the east and the Aleutian-Alaska Range to the west. A rim of lowlands separates the mountains from most of the inlet. The lowlands are predominantly swampy and forested with spruce, birch, and aspen.

The Cook Inlet is located in the transitional climatic zone. Although Kenai and Drift River Terminal are located on an arm of the Pacific Ocean, their climate is more continental than maritime in character.

Climatic data are lacking for the western shore of Cook Inlet. Unofficial weather records are available from Tyonek, approximately fifty miles northeast of the Terminal, and from Kenai, an official observation station across Cook Inlet. Climatic differences for these two stations are small and since Kenai has the longest record the following discussion will be primarily based on Kenai records and other special studies. Means and extremes for Kenai are presented in Table 5-7.

Temperatures

Normal monthly temperatures range from approximately 10°F in January to the 50s (°F) in July and August. During the winter, when anticyclonic conditions prevail over interior Alaska with clear skies and calm or light winds, temperatures may be as low as -30°F or -40°F for one or two days. Record low at Kenai has been -48°F. The record high has been 89°F. Kenai has an average of about 6 days per year with temperatures below zero.

TABLE 5-7

NORMALS, MEANS, AND EXTREMES FOR KENAI

LATITUDE 60° 34' N
LONGITUDE 151° 18' W
ELEVATION 85 feet

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU
CLIMATOLOGICAL SUMMARY, KENAI, ALASKA
MEANS AND EXTREMES FOR PERIOD OF RECORD THROUGH 1952

Month	Temperature – Means – Daily maximum	Temperature – Means – Daily minimum	Temperature – Means – Monthly	Temperature – Extremes – Record highest	Year	Temperature – Extremes – Record lowest	Year	Mean degree days	Precipitation – Mean total	Precipitation – Maximum monthly	Year	Precipitation – Minimum monthly	Year	Precipitation – Maximum in 24 hours	Year	Snow, Sleet, Hail – Mean total	Snow, Sleet, Hail – Maximum monthly	Year	Snow, Sleet, Hail – Maximum in 24 hours	Year	Snow, Sleet, Hail – Max depth on ground	Year	Wind – Prevailing direction	Mean number of days – Precip .01 or more	Mean number of days – Max temp – 70° or abv	Mean number of days – Max temp – 32° or blw	Mean number of days – Min temp – 32° or blw	Mean number of days – Min temp – 0° or blw	Month
(a)	16	16	16	21		21		16	22	22		22		18		18	18		15		15		14	22	15	16	18	18	(a)
JAN	19.4	0.6	10.0	49	1903	-45	1947	1705	0.79	2.03	1949	T	1886	0.83	1951	12.8	59.2	1949	8.9	1946	53	1949	NNE	7	0	25	31	14	JAN
FEB	26.9	7.3	17.1	48	1905+	-48	1947	1341	0.80	2.18	1903	T	1950	1.27	1948	9.8	35.8	1903	18.0	1903	46	1946	NNE	7	0	19	28	9	FEB
MAR	33.2	10.6	21.9	59	1905	-34	1902	1336	0.87	1.98	1885+	0.02	1904	1.25	1946	9.8	25.3	1947	7.5	1947	52	1946	N	7	0	13	30	7	MAR
APR	42.1	22.8	32.5	68	1883+	-22	1944	975	0.80	2.71	1946	T	1948	1.51	1946	4.9	28.4	1949	8.5	1945	57	1946	N	5	0	3	26	1	APR
MAY	52.0	34.0	43.0	79	1906	12	1945	682	0.77	2.98	1886	T	1904	0.51	1944	0.7	1.0	1949	1.0	1949	7	1946	SW	7	*	*	11	0	MAY
JUN	57.7	41.2	49.5	87	1903	28	1905+	465	1.10	2.45	1950	0.06	1901	0.94	1945	0.0	0.0		0.0		0		SSW	8	2	0	2	0	JUN
JUL	60.8	45.4	53.1	82	1899	27	1904	369	2.20	5.49	1907	0.32	1870	1.45	1908	0.0	0.0		0.0		0		SSW	11	3	0	*	0	JUL
AUG	61.4	44.7	53.1	79	1885+	25	1904	369	3.04	6.26	1905	0.87	1950	2.00	1905	0.0	0.0		0.0		0		SW	13	3	0	2	0	AUG
SEP	55.1	37.7	46.4	89	1883	11	1904	558	3.28	10.00	1907	0.78	1905	1.90	1907	0.0	0.0		0.0		0		N	13	*	0	9	0	SEP
OCT	43.6	28.8	36.2	80	1901	- 5	1900	893	2.09	5.42	1882	0.41	1884	1.77	1899	2.6	11.0	1900	3.0	1904	6	1903+	NNE	11	0	2	19	1	OCT
NOV	30.0	14.7	22.4	51	1947	-27	1903	1278	1.70	14.59	1882	0.16	1950	1.00	1907	8.2	18.4	1945	11.0	1902	16	1903+	NNE	9	0	17	28	6	NOV
DEC	21.6	5.6	13.6	45	1901	-43	1902	1593	1.07	2.47	1943	0.18	1903	1.00	1907	13.0	32.3	1946	12.0	1902	37	1902	NNE	9	0	24	30	11	DEC
Year	42.0	24.5	33.3	89	Sep 1883	-48	Feb 1947	11564	18.52	14.59	Nov 1882	T	Jan+ 1886+	2.00	Aug 1905	61.8	59.2	Jan 1949	18.0	Feb 1903	57	Apr 1946	NNE	107	8	103	216	49	Year

Source: Environmental Data Service (NOAA)

Precipitation

Precipitation is light in the winter and spring months, increasing with storm frequency in the summer months to a maximum in September (3.29 in.) when the average position of the Aleutian Low has moved into the Bristol Bay area. Annual precipitation may vary from 13 to 22 in.

The first measurable snow falls in late October or early November, usually reaching maximum accumulations in January when snow depths may be 11 in. or more. The last snowfall generally occurs in April, with snow cover usually disappearing by May 1. The maximum snowfall in 24 hrs has been around 18 in.

Winds

Prevailing winds are from the southwest during May through August and from the north or northeast during the remainder of the year. High velocity winds can occur with either wind direction and have been recorded between 43 and 61 knots. As noted before, higher wind velocities may occur over Cook Inlet.[8]

Cloudiness and Fog

Cloudiness is slightly more prevalent during the warm summer months than in the cooler winter months. Fog occurs on an average of 80 to 90 days a year, reaching a maximum frequency in December and January when it is observed on 10 to 15 days a month. A secondary fog maximum occurs in August when fog is observed on an average of 11 days. Fog conditions are usually of short duration.

Offshore Sea Conditions and Marine Weather

Local Sea and Ice Conditions

Tides Mean tidal ranges are around 17.7 ft and the diurnal range is 20.7 ft near Kenai. Highest tide is 26 ft and extreme range is 32 ft. Tidal currents are strong and must be considered at all times. Tidal currents may reach 8 knots in certain locations at times.(4)

Ice Four categories of ice exist in Cook Inlet during the winter: 1) sea ice, 2) beach ice, 3) stamukhas, and 4) river ice.(2) During the winter the upper inlet is generally obstructed by ice but rarely, if ever, freezes solid due to the large tidal range. The inlet is usually free of ice on the east side south of Anchor Point and on the west side south of Cape Douglas.

The sea ice usually interferes with ship navigation from late November to late March and normal operations without much sea ice occur between May 1 to November 1. The average date for ice breakup at Kenai is April 2; the earliest date has been March 18 and the latest April 14. The average date for ice freeze-up is December 10; the earliest date has been November 23 and the latest December 26.

Data for other sea conditions are not available from SSMO. Further information on Cook Inlet can be obtained from References 1, 8, and 10.

Local Flying Weather

Flight weather data are available for Kenai (Table 5-8); however, these data may not be totally representative of flying conditions across Cook Inlet at the Drift River Terminal. Generally, 25 to 30 days on the average have favorable flying conditions with the winter months, especially February, having the poorest flying weather. Storminess and fog during the summer months have a tendency to interfere with favorable flying weather, but most late mornings and afternoons are good. Thunderstorms are rare over the peninsula; however, the usual summertime buildup of cumulus and cumulonimbus occurs over the surrounding mountains. Turbulence may be present in the afternoons.

TABLE 5-8

KENAI - FLYING WEATHER

Average Frequency (%) When Ceiling $\leq$ 300 Ft and Visibility $\leq$ 1 Mi (based on 12 yrs of data)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
3.5	3.4	1.6	1.8	0.3	1.3	1.5	1.4	0.9	1.0	2.0	3.4

Mean Number of Days Ceiling $\geq$ 1,000 Ft and Visibility $\geq$ 3 Mi (based on 12 yrs of data)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
28.0	25.2	29.1	28.2	30.5	28.3	29.0	29.0	28.7	29.6	27.8	27.7

5.1.5 Unimak Pass

Local Unimak Weather

Unimak Pass (∿ 10 mi wide) is the first ship passage southwest of the Alaska Peninsula into the Bering Sea. It is located between Unimak Island and the Krenitzen Islands. Unimak Island is an island of volcanoes, steep cliffs, and rocky outcroppings with little vegetation. The climate is maritime due to the ocean exposure.

The weather of the Aleutians is characterized by persistent overcast skies, high winds and severe storms. The weather is extremely localized, conditions of fog, low cloud ceilings and clear weather frequently being encountered within a distance of 20 miles. Clear weather over large areas seldom persists for long periods. An important characteristic of the weather in this area is that the northern shores of the islands have far better weather and much less fog than the southern shores.[4]

Climatic data are available from Cape Sarichef, Unimak, Scotch Cap and Cold Bay. Cold Bay is approximately 50-70 miles to the northeast and has the most complete climatic summary. Means and extremes are given in Table 5-9. However, Cape Sarichef's data were utilized in the following discussion as much as possible (Table 5-10). In addition, a section on the climate of the Bristol Bay (which includes this region) from "The Bristol Bay Environment"[11] was reviewed for this report.

Temperatures

Normal monthly temperatures at Cape Sarichef range from the 30s in January and February to the low 50s in August. Temperature extremes, both seasonal and diurnal, are generally confined to within 10°F. Extremely cold temperatures are unknown but air overlying the frozen ocean surface of the

TABLE 5-9

NORMALS, MEANS, AND EXTREMES FOR UNIMAK

Month	Temperature: Normal: Daily maximum	Temperature: Normal: Daily minimum	Temperature: Normal: Monthly	Temperature: Extremes: Record highest	Year	Temperature: Extremes: Record lowest	Year	Normal heating degree days (Base 65°)	Precipitation: Normal total	Precipitation: Maximum monthly	Year	Precipitation: Minimum monthly	Year	Precipitation: Maximum in 24 hrs	Year	Snow, Ice pellets: Mean total	Snow, Ice pellets: Maximum monthly	Year	Snow, Ice pellets: Maximum in 24 hrs	Year
(a)	(b)	(b)	(b)	28		29		(b)	(b)	27		27		27		22	22		22	
J	32.6	22.9	27.8	49	1969+	-5	1962+	1153	2.32	8.46	1948	0.60	1956	2.09	1948	8.8	19.9	1971	9.2	1971
F	32.7	23.3	28.0	50	1957	-9	1947	1036	3.17	7.87	1944	0.08	1958	2.49	1956	9.9	23.4	1965	9.7	1965
M	33.5	24.0	28.8	54	1948	-13	1971	1122	1.75	3.89	1948	0.41	1972	1.34	1956	8.2	17.6	1949	7.1	1949
A	38.3	28.3	33.3	60	1948	4	1943	951	1.46	3.83	1970	0.02	1948	1.76	1951	5.0	14.7	1959	6.8	1956
M	44.6	34.3	39.5	65	1964	21	1949	791	2.29	6.37	1958	0.62	1967	2.22	1958	2.1	9.2	1971	3.8	1971
J	50.3	40.3	45.3	69	1953	29	1952	391	1.95	6.98	1952	0.12	1962+	2.10	1971	T	0.5	1971	2.0	1971
J	54.3	45.0	49.7	77	1960	36	1971+	674	1.82	4.63	1956	0.28	1950	1.74	1969	0.0	0.0		0.0	
A	55.7	46.9	51.3	78	1948	33	1946	425	4.25	9.97	1951	1.40	1948	2.17	1951	0.0	0.0		0.0	
S	52.5	42.5	47.5	70	1960	27	1972	525	4.32	9.79	1965	0.91	1952	3.43	1965	T	0.2	1972	0.2	1972
O	44.7	35.5	40.1	69	1964+	12	1966	772	4.59	8.02	1968	1.88	1961	4.90	1968	2.9	15.6	1968	11.4	1968
N	38.6	30.1	34.4	54	1970+	1	1963	918	3.79	8.94	1960	1.46	1963	3.43	1972	5.7	21.6	1948	8.6	1964
D	33.4	24.1	28.8	51	1970	-9	1950	1122	2.59	6.49	1972	0.19	1956	1.94	1972	8.4	20.3	1948	8.4	1960
YR	42.6	33.1	37.9	78	AUG. 1948	-13	MAR. 1971	9880	34.30	9.97	AUG. 1951	0.02	APR. 1948	4.90	OCT. 1968	51.0	23.4	FEB. 1965	11.4	OCT. 1968

Month	Relative humidity: Hour 01 (Local time)	Hour 07	Hour 13	Hour 19	Wind &: Mean speed	Prevailing direction	Fastest mile: Speed	Fastest mile: Direction	Year	Pct. of possible sunshine	Mean sky cover, sunrise to sunset	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog	Temperatures: Max.: 90° and above ‡	Max.: 32° and below	Min.: 32° and below	Min.: 0° and below	Average daily solar radiation - langleys
(a)	17	17	17	17	17	8	17	17			17	17	17	17	27	22	17	17	28	28	29	29	
J	84	85	82	84	17.8	SSE	67	14	1958		8.1	3	6	22	17	3	0	2	0	12	29	0	
F	85	85	81	84	17.9	SSE	72	16	1967		8.3	2	4	22	16	3	0	2	0	11	24	0	
M	85	84	78	84	17.5	NNW	67	11	1961+		8.1	2	7	22	16	3	0	2	0	12	27	*	
A	85	84	78	82	18.4	SSE	60	15	1965		8.9	1	4	25	14	2	0	1	0	6	23	0	
M	87	85	77	82	16.8	SSE	56	16	1966		9.1	0	4	27	16	1	0	2	0	1	9	0	
J	89	86	77	83	15.9	NNW	63	11	1959		9.2	0	3	27	15	0	0	2	0	0	0	0	
J	91	89	86	86	15.5	SSE	54	17	1972		9.4	0	3	28	16	0	0	5	0	0	0	0	
A	91	90	83	88	16.4	SSE	54	15	1966		9.5	0	3	29	19	0	0	3	0	0	0	0	
S	88	88	79	86	16.3	SSE	58	18	1956		9.1	0	4	26	20	0	0	1	0	0	1	0	
O	84	84	77	83	16.9	WSW	55	18	1961		8.6	1	5	25	22	1	0	2	0	0	9	0	
N	83	83	79	83	17.7	SSE	66	14	1967		8.4	1	6	22	21	2	0	1	0	3	19	0	
D	84	83	82	84	17.0	NNW	64	11	1960		8.6	1	5	25	18	3	0	2	0	11	26	0	
YR	86	86	79	84	17.0	SSE	72	16	FEB. 1967		8.8	11	55	301	210	17	*	25	1	57	162	*	

All data available for period 1942 to date considered in extracting extremes of temperature and liquid precipitation above.

(a) Length of record, years, based on January data. Other months may be for more or fewer years if there have been breaks in the record.
(b) Climatological standard normals (1931-1960).
* Less than one half.
\+ Also on earlier dates, months, or years.
T Trace, an amount too small to measure.
Below zero temperatures are preceded by a minus sign. The prevailing direction for wind in the Normals, Means, and Extremes table is from records through 1963.
‡ 70° at Alaskan stations.

Unless otherwise indicated, dimensional units used in this bulletin are: temperature in degrees F.; precipitation, including snowfall, in inches; wind movement in miles per hour; and relative humidity in percent. Heating degree day totals are the sums of negative departures of average daily temperatures from 65° F. Cooling degree day totals are the sums of positive departures of average daily temperatures from 65° F. Sleet was included in snowfall totals beginning with July 1948. The term "Ice pellets" includes solid grains of ice (sleet) and particles consisting of snow pellets encased in a thin layer of ice. Heavy fog reduces visibility to 1/4 mile or less.

Sky cover is expressed in a range of 0 for no clouds or obscuring phenomena to 10 for complete sky cover. The number of clear days is based on average cloudiness 0-3, partly cloudy days 4-7, and cloudy days 8-10 tenths.

Solar radiation data are the averages of direct and diffuse radiation on a horizontal surface. The langley denotes one gram calorie per square centimeter.

& Figures instead of letters in a direction column indicate direction in tens of degrees from true North; i.e., 09 - East, 18 - South, 27 - West, 36 - North, and 00 - Calm. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. If figures appear in the direction column under "Fastest mile" the corresponding speeds are fastest observed 1-minute values.

Source: Environmental Data Service (NOAA)

TABLE 5-10

MEANS AND EXTREMES FOR CAPE SARICHEF

STATION: CAPE SARICHEF, ALASKA   LATITUDE: 54° 36'N   LONGITUDE: 164° 56'W   ELEVATION: 175'

MONTH	TEMPERATURE (°F)							PRECIPITATION (IN INCHES)												MEAN NUMBER OF DAYS				
	Means			Extremes									Snow, Ice Pellets								Temperature Max		Temperature Min	
	Daily Maximum	Daily Minimum	Monthly	Record Highest	Year	Record Lowest	Year	Mean	Greatest Daily	Year	Greatest Monthly	Year	Mean	Greatest Monthly	Year	Greatest Daily	Year	Greatest Depth on Ground	Year	Precipitation .10 Inches or more	70° and Above	32° and Below	32° and Below	0° and Below
(a)	16	16	16	16	-	16	-	16	16	-	16	-	13	13	-	13	-	13	-	14	16	16	16	16
J	35.9	27.3	31.6	57	1963	6	1956	1.99	1.50	1964	4.25	1970	5.3	13.7	1960	5.0	1960	10	1961	6	0	8	22	0
F	35.0	25.5	30.3	58	1957	-1	1954	1.69	1.50	1966	4.07	1966	9.7	32.2	1961	6.0	1957	7	1965	6	0	9	23	*
M	36.7	26.5	31.6	58	1967	-5	1956	1.46	1.73	1963	2.80	1955	6.3	21.1	1961	13	1964	16	1964	4	0	7	24	*
A	38.8	29.6	34.2	58	1955	13	1956	1.16	0.75	1957	2.48	1957	2.6	12.9	1960	2.0	1964+	3	1969+	4	0	4	20	0
M	44.1	35.0	39.6	59	1952	14	1953	1.76	1.20	1957	3.46	1958	0.4	2.0	1960	2.0	1957	1	1965+	5	0	*	8	0
J	48.3	39.8	44.1	70	1969	23	1960	1.49	2.10	1970	6.49	1958	T	T	1962+	T	1962+	0	-	3	*	0	1	0
J	52.4	44.3	48.4	74	1969	34	1954	2.98	1.29	1955	6.99	1955	T	T	1953	T	1953	0	-	8	*	0	0	0
A	54.1	45.7	49.9	74	1954	28	1956	2.89	1.60	1958+	5.93	1956	T	T	1953	T	1953	0	-	8	*	0	*	0
S	51.0	42.9	47.0	72	1965	25	1956	3.64	3.20	1965	16.02	1965	0.0	0.0	-	0.0	-	0	-	7	*	0	*	0
O	44.2	36.4	40.3	61	1957+	22	1953	3.25	1.91	1956	5.54	1960	0.5	1.5	1964+	1.5	1963	3	1966	10	0	*	7	0
N	40.2	32.5	36.4	58	1952	23	1963	3.36	1.70	1952	6.62	1960	3.6	9.3	1960	3.0	1965+	6	1968	10	0	1	14	0
D	36.1	27.5	31.8	57	1961	6	1955	1.81	1.43	1970	5.39	1970	8.2	24.6	1960	4.0	1965	9	1958	6	0	6	24	0
YR	43.1	34.4	38.8	74	1969+	-5	1956	27.48	3.20	1965	16.02	1965	32.2	32.2	1961	13.0	1964	16	1964	77	*	35	145	0

(a) Period of Record
* Less than one half
+ Also on earlier dates, months, or years
T Trace, an amount too small to measure

Source: Environmental Data Service (NOAA)

Bering Sea may take on continental characteristics and bring rather cold temperatures to the Unimak area. Record lows vary between -5°F to 9°F depending upon location and exposure but these are rare occurrences. Record highs are around 74°F.

Precipitation

Precipitation is frequent, but not particularly abundant. Measurable precipitation is realized on an average of about 200 days per year. Maximum precipitation occurs during the fall months (3 to 4 in.) and the least in the spring months (1 to 1½ in.).

Snow has occurred in each month and may reach 16 in. or more on the ground during the winter months. The maximum snowfall in 24 hrs has been around 13 in. During the winter months visibilities are frequently restricted by blowing snow.

Winds

The high frequency of cyclonic storms crossing the Northern Pacific and the Bering Sea is the principal reason for the high velocity winds observed in this region. Monthly mean winds vary from 10 to 17 knots and extreme short-term winds have reached 64 to 74 knots. Generally, the strongest speeds occur with east to southeast winds and occasionally southwest winds. Local topography may enhance the higher wind speeds by channeling, venturi and leeside effects.

Cloudiness and Fog

Cloudiness is frequent in the area and greatly restricts the amount of sunshine. Cloudiness averages nearly nine-tenths sky cover the year around. The mean number of cloudy days per year is around 200.

Fog is the principal reason for reduced visibility in the area; the frequency of fog increases during the summer

months when the air contains the most moisture and is warmer than the ocean. Scotch Cap averages fog 11% of the whole year and reaches 32% during midsummer. December and January have the least fog, with occurrences less than 1% of the time.

Fog is most likely to occur with winds from southerly or southeasterly directions and least likely with winds from the north.

Offshore Sea Conditions and Marine Weather

Local Sea and Ice Conditions

Tides Mean tidal ranges are around 3.3 ft and the diurnal range is 5.3 ft at Cape Sarichef. At the mouth of Bristol Bay, off Scotch Cap, the incoming Pacific tide exceeds 3.4 knots and the ebb is more than 3.0 knots.[4]

Ice In an average year, the Arctic ice pack begins to move southward into the Bering Sea during late October, reaching its southernmost extent during February. The Unimak Pass region is approximately the southernmost extent of the ice pack and coverage is usually less than 0.1 or open.

Data for other sea conditions may be obtained from the SSMO Volume 13, Area 7 - Unimak.[12] The following information was summarized from that volume.

Sea Temperatures

During the winter months water temperatures are normally 37 to 41°F but may vary from 27 to 46°F. During the summer months temperatures are normally 49 to 54°F but may vary from 37 to 64°F.

Sea Heights

The most frequent sea height is between 3 and 6 ft. During extreme wind speeds (>50 knots) waves of 33 to 40 ft have been reported. In rare situations, tsunami waves near the coastal areas have reached even greater heights.[13] The Krenitzen Islands provide considerable protection from southerly and southwesterly winds, but during easterly or northerly winds the seas in Unimak Pass are accentuated by the Pacific Current.[4]

Fog

Offshore fog occurs during each month of the year with the maximum frequency (14-22%) during June, July, and August and minimum frequency (1-3%) during October, November, and December.

Local Flying Weather

Local flight weather data are not available for the Unimak Pass area. The nearest station is Cold Bay. Data are given in Table 5-11 but these statistics may not be totally representative of the Unimak Pass area.

As the Cold Bay statistics indicate, this region is notorious for poor flying conditions due to the frequent storms moving through the area. Low cloud ceilings, reduced visibilities and high winds are usually the normal situation. Generally, fall (September and October) is the best season for flying.

During southeast wind episodes, the northern side of the peninsula is better for flying than the south side; however, leeside turbulence can be expected near the mountains. If a storm produces a predominantly west or northwest wind, the effects are about the opposite.

TABLE 5-11

COLD BAY - FLYING WEATHER

Average Frequency (%) When Ceiling ≤ 300 Ft and Visibility ≤ 1 Mi

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
7.5	6.6	4.0	3.3	2.2	3.3	5.8	5.1	1.2	0.6	2.0	5.2

Mean Number of Days Ceiling ≥ 1,000 Ft and Visibility ≥ 3 Mi

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
23.5	21.4	25.6	24.0	24.1	21.6	18.5	19.0	23.5	28.4	26.4	25.8

5.1.6 Offshore Port Moller

Local Port Moller Weather

Port Moller is located in the northwestern coastal region of the Alaska Peninsula and in the Nushagak-Bristol Bay lowlands. The Aleutian Mountain range is within 25 miles, to the southwest, southeast and east.

Weather records are available for a short period of time (∿5 yrs) but evidently the observation station is not active at this time.[11] The climate of the Port Moller region is of the transitional type, i.e., maritime during most of the year but with a tendency toward continental characteristics during mid-summer and mid-winter periods.

Temperatures

Normal monthly temperatures at Port Moller range from the middle 20s in winter to the high 40s in the summer. Record lows or highs have not been established because of the short

climate record but other records[14] indicate absolute minimum temperatures near -20°F and absolute maximums near 80°F.

Precipitation

Measurable precipitation is observed over 200 days a year and approximately 11 to 24 days a month. Maximum precipitation (~6-8 in.) is during the summer months and minimum amounts (~1-2 in.) occur during late winter.

Snowfall may occur during any month of the year. Mean snow depths in the winter reach 9 in. but during short periods the snow depth may reach 25 to 36 in.

Winds

Monthly mean winds vary from 7 to 11 knots and extreme winds have been observed to 44 knots. Strongest winds are associated with south and southeast winds but winds can be strong from the other directions also. Winds from the east and southeast may be accompanied by strong turbulence, presumably due to leeside mountain effects.[15] Blowing snow occurs during the winter months.

Cloudiness and Fog

Cloudiness is abundant with cloudy skies prevailing over 70% of the time. Average sky cover varies from seven to nine-tenths, reaching a maximum during the summer.

Fog has been observed in every month of the year and maximum frequency occurs during the summer months when 20% to 30% of the hourly observations may have visibility below 1 mile due to fog. Fog reported on the higher terrain may actually appear to an observer near sea level to be low clouds.

Offshore Sea Conditions and Marine Weather

Local Sea and Ice Conditions

Tides - Mean tidal range is around 7.5 ft and the diurnal range is 10.8 ft at Port Moller. The tide current at flood stage is 1.7 knots and at ebb stage is 2.0 knots.

Ice - The Arctic ice pack usually influences Port Moller by December. The ice, except in sheltered regions, is in detached fields, floes, and cakes which are continually kept in motion, breaking up, piling, and telescoping by the action of winds, tides, and bay currents.[4] Coverage during January and February is between 0.1 and 0.4, or scattered, and the ice coverage is usually gone by April or May, depending on the severity of the winter.

Data for offshore sea conditions may be obtained from SSMO Volume 14, Area 11 - Bristol Bay.[16] The following information was extracted from this volume. These data apply to the overall Bristol Bay region and may not represent local conditions near Port Moller at all times.

Sea Temperatures

During the winter months the range of sea temperatures is 29-44°F with maximum frequencies occurring at 36°/37°F and 31°/32°F intervals. During the summer the temperature distribution is more normal, with temperatures of 45-52°F occurring with maximum frequency and the range varying from 31-60°F. Additional information on short-term sea temperature distributions for Bristol Bay can be found in References 1 and 11.

Sea Heights

The most frequent sea height is between 1 and 6 ft. During extreme wind speeds (>50 knots) 26-32 ft waves have been reported.

Despite the large fetch available to the west and north, most waves appear to be locally generated. The waves tend to be irregular, with steep crests and flattened troughs, in contrast to the smooth, sinusoidal form of "swell." Because of the shape, sea waves tend to batter ships out of proportion to their size.[11]

Fog

Fog over the bay occurs in each month. As expected, the highest frequency is during the summer months (12-19%) and the lowest frequency occurs during the fall months.

Local Flying Weather

Limited flight weather data for Port Moller are presented in Table 5-12. The nearest station with extensive records is Cold Bay. Flying weather is slightly better at Port Moller than at Cold Bay because of the port's northern exposure.

5.1.7 Kvichak Bay

Local Kvichak Bay Weather

Kvichak Bay is a large arm at the head of Bristol Bay. An official weather observation station is located at the King Salmon Airport which lies about 18 miles inland from the shore. The terrain in this area is gently rolling and barren tundra. The Aleutian Range is approximately 60 miles to the east.

The climate is transitional, i.e., predominantly maritime in character with continental influences causing temperature extremes much beyond the normal climatic range. Means and extremes are presented in Table 5-13.

TABLE 5-12

PORT MOLLER FLYING CONDITIONS

PORT MOLLER

CEILING vs VISIBILITY

Month	Ceiling	≥ 3	≥ 1½	≥ 1	≥ 3/4	≥ 1/2	≥ 1/4	≥ 0
JANUARY	≥ 1800	80.0	80.6	81.1	81.2	81.2	81.2	81.3
	≥ 1500	81.9	83.0	83.6	83.7	83.8	83.9	84.0
	≥ 1200	82.0	83.3	83.9	84.0	84.1	84.2	84.3
	≥ 1000	84.6	84.8	85.0	85.2	85.4	85.5	85.6
	≥ 900	84.6	85.8	88.0	88.2	88.4	88.5	88.6
	≥ 800	84.8	87.2	88.4	88.6	88.8	88.9	89.0
	≥ 700	84.8	87.2	88.4	88.6	88.8	88.9	89.0
	≥ 600	85.0	87.6	88.8	89.0	89.3	89.5	89.6
	≥ 500	85.6	87.4	89.8	90.9	91.7	92.3	92.5
	≥ 400	85.8	89.6	90.0	91.3	92.1	92.8	93.2
	≥ 300	86.1	89.0	90.4	91.7	92.7	93.6	94.1
	≥ 200	86.1	89.5	91.0	92.3	93.5	95.2	96.4
	≥ 100	86.1	89.5	91.0	92.3	93.5	95.3	98.0
	≥ 0	86.1	89.5	91.0	92.3	93.5	95.3	100.0
JULY	≥ 1800	55.0	55.4	55.4	55.4	55.4	55.7	55.7
	≥ 1500	58.4	58.8	58.8	58.8	58.8	59.1	59.2
	≥ 1200	59.7	60.1	60.1	60.1	60.1	60.4	60.5
	≥ 1000	62.6	62.9	63.0	63.0	63.1	63.3	63.4
	≥ 900	62.8	63.2	63.3	63.3	63.4	63.7	63.8
	≥ 800	63.2	63.6	63.8	63.8	63.9	64.3	64.4
	≥ 700	63.2	63.6	63.8	63.8	63.9	64.3	64.4
	≥ 600	63.2	63.7	63.9	63.9	64.0	64.4	64.5
	≥ 500	64.2	65.0	65.5	65.5	66.3	66.8	67.0
	≥ 400	64.2	65.1	65.5	65.5	66.7	67.3	67.5
	≥ 300	64.4	65.3	66.0	66.0	67.2	68.3	68.7
	≥ 200	64.5	65.5	66.4	66.4	68.1	70.9	71.3
	≥ 100	64.6	65.7	66.7	66.7	68.7	73.1	76.4
	≥ 0	64.6	65.7	66.7	66.7	68.7	73.3	100.0

Month	Ceiling	≥ 3	≥ 1½	≥ 1	≥ 3/4	≥ 1/2	≥ 1/4	≥ 0
APRIL	≥ 1800	65.3	65.8	66.0	66.0	66.1	66.1	66.1
	≥ 1500	68.7	69.4	69.6	69.6	69.9	69.9	69.9
	≥ 1200	69.6	70.6	70.9	70.9	71.2	71.2	71.2
	≥ 1000	72.1	73.6	74.1	74.2	74.9	74.9	74.9
	≥ 900	72.2	73.7	74.2	74.3	75.0	75.0	75.0
	≥ 800	73.5	75.5	76.0	76.1	77.2	77.4	77.5
	≥ 700	73.7	75.7	76.2	76.3	77.4	77.7	77.8
	≥ 600	73.9	75.9	76.4	76.6	77.7	78.1	78.2
	≥ 500	75.0	77.8	78.8	79.1	81.6	82.4	82.4
	≥ 400	75.0	77.9	79.0	79.3	81.8	82.7	83.2
	≥ 300	75.4	78.6	79.6	79.9	82.9	84.3	85.0
	≥ 200	75.7	79.0	80.1	80.4	83.9	86.2	88.4
	≥ 100	75.7	79.1	80.3	80.6	84.3	87.3	93.3
	≥ 0	75.7	79.1	80.3	80.6	84.3	87.3	100.0
OCTOBER	≥ 1800	71.9	72.1	72.2	72.2	72.3	72.3	72.4
	≥ 1500	77.8	78.3	78.4	78.4	78.5	78.5	78.6
	≥ 1200	78.7	79.2	79.3	79.3	79.4	79.4	79.4
	≥ 1000	82.3	83.2	83.3	83.3	83.3	83.3	83.4
	≥ 900	83.0	83.8	83.9	83.9	84.0	84.0	84.1
	≥ 800	83.9	84.9	85.0	85.0	85.1	85.1	85.2
	≥ 700	84.0	85.0	85.1	85.1	85.2	85.2	85.3
	≥ 600	84.4	85.3	85.4	85.4	85.5	85.5	85.6
	≥ 500	85.1	86.5	86.8	86.8	87.2	87.2	87.3
	≥ 400	85.2	86.9	87.2	87.2	87.5	87.5	87.7
	≥ 300	85.4	87.3	87.7	87.8	89.0	89.3	89.6
	≥ 200	85.6	87.5	88.2	88.3	89.9	91.1	91.7
	≥ 100	85.7	87.6	88.3	88.5	90.4	92.3	94.6
	≥ 0	85.7	87.6	88.3	88.5	90.4	92.3	100.0

Due to the cumulative nature of this presentation, it is possible to determine the percentage frequency of occurrence for any given limit of ceiling or visibility separately, or in combination of ceiling and visibility. The totals progress to the right and downward. Ceiling may be determined independently by referring to totals in the extreme right hand column. Also, visibility may be determined independently by reference to the horizontal row of totals at the bottom of the page. The percentage frequency for which the station was meeting or exceeding any given set of minima may be determined from the figure at the intersection of the appropriate ceiling column and visibility row.

4 years of record

Source: Air Weather Service U.S.A.F.

TABLE 5-13

NORMALS, MEANS, AND EXTREMES FOR KVICHAK BAY

Month	Temperature — Normal — Daily maximum	Temperature — Normal — Daily minimum	Temperature — Normal — Monthly	Temperature — Extremes — Record highest	Year	Temperature — Extremes — Record lowest	Year	Normal heating degree days (Base 65°)
(a)	(b)	(b)	(b)	9		9		(b)
J	20.8	5.9	13.4	47	1968	-34	1972+	1600
F	25.2	9.5	17.4	46	1970+	-35	1969	1333
M	27.8	11.1	19.5	54	1965	-42	1971	1411
A	40.8	24.8	32.8	59	1965	-4	1972	966
M	51.9	34.7	43.3	75	1964	13	1965	673
J	60.9	41.9	51.4	80	1969	29	1965	408
J	63.0	46.8	54.9	85	1971	33	1966	313
A	61.4	47.8	54.6	84	1968	32	1971+	322
S	55.3	40.5	47.9	71	1964	18	1968	513
O	42.7	28.6	35.7	62	1967	-1	1970+	908
N	29.4	14.6	22.0	48	1970	-14	1971+	1290
D	20.7	5.6	13.2	48	1970	-30	1965	1606
YR	41.7	26.0	33.8	85	JUL. 1971	-42	MAR. 1971	11343

Month	Precipitation	Relative humidity	Wind	Pct. of possible sunshine	Mean sky cover	Mean number of days	Average daily solar radiation
J	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
F	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
M	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
M	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
J	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
J	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
O	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
YR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows:
Highest temperature 88 in June 1953.

(a) Length of record, years, based on January data. Other months may be for more or fewer years if there have been breaks in the record.
(b) Climatological standard normals (1931-1960).
* Less than one half.
\+ Also on earlier dates, months, or years.
T Trace, an amount too small to measure.
Below zero temperatures are preceded by a minus sign.
The prevailing direction for wind in the Normals, Means, and Extremes table is from records through 1963.
‡ ≥ 70° at Alaskan stations.

Unless otherwise indicated, dimensional units used in this bulletin are: temperature in degrees F.; precipitation, including snowfall, in inches; wind movement in miles per hour; and relative humidity in percent. Heating degree day totals are the sums of negative departures of average daily temperatures from 65° F. Cooling degree day totals are the sums of positive departures of average daily temperatures from 65° F. Sleet was included in snowfall totals beginning with July 1948. The term "ice pellets" includes solid grains of ice (sleet) and particles consisting of snow pellets encased in a thin layer of ice. Heavy fog reduces visibility to 1/4 mile or less.

Sky cover is expressed in a range of 0 for no clouds or obscuring phenomena to 10 for complete sky cover. The number of clear days is based on average cloudiness 0-3, partly cloudy days 4-7, and cloudy days 8-10 tenths.

Solar radiation data are the averages of direct and diffuse radiation on a horizontal surface. The langley denotes one gram calorie per square centimeter.

& Figures instead of letters in a direction column indicate direction in tens of degrees from true North; i.e., 09 - East, 18 - South, 27 - West, 36 - North, and 00 - Calm. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. If figures appear in the direction column under "Fastest mile" the corresponding speeds are fastest observed 1-minute values.

Source: Environmental Data Service (NOAA)

Temperatures

Normal monthly temperatures at King Salmon range from the mid-teens in winter to the mid-50s in summer. The record low is -43°F and the record high is 88°F. Mean number of days 0°F and below is 55.

Precipitation

Measurable precipitation is observed on an average of about 150 days per year. The annual precipitation varies from 10 to 25 in. and the maximum precipitation occurs during August and September. Maximum in 24 hrs has been 2 in.

Seasonal snowfall averages about 45 in., with the maximum depth on the ground during the winter season averaging about 10 in. A considerable amount of snow is deposited in snow showers which move inland from the Bristol Bay area. Maximum snowfall in 24 hrs has been about 10 in.

Winds

The area experiences rather strong winds from December through March due to the passage of eastward-moving Aleutian cyclonic storms. Mean monthly winds are around 9-10 knots and prevail from the north during the winter and from the south or southwest in the summer. Highest winds are usually from the east or southeast and have reached 43 knots or more in every month with an extreme speed of 82 knots in February, 1952.

Winds in excess of 20 knots which are opposed to the bay currents make the bay quite rough for vessels of light draft.[4]

Cloudiness and Fog

Cloudiness is frequent, with the mean number of cloudy days per year exceeding 240. Cloud coverage averages about eight-tenths during the year.

Fog occurs quite frequently due to the high moisture content of the air and reaches a maximum during July and August. Mean number of days with heavy fog (visibility $\leq$ one-fourth mile) is around 33 days a year.

During the winter months the high moisture content of the air causes substantial accumulation of frost on outside objects and structures.

Mirages

Mirages are seen frequently in the Kvichak Bay area during periods of calm weather and particularly at low tide. This optical phenomenon distorts the appearance of bluffs and shorelines and makes tanks and other elevated structures visible at greater distances than their heights would warrant.[4]

Offshore Sea Conditions and Marine Weather

Local Sea and Ice Conditions

Tides - In the Kvichak Bay and River the tidal current is very strong. Mean tidal ranges are 15 ft, 18.4 ft and 13.8 ft and the diurnal ranges are 19.7 ft, 22.6 ft and 16.4 ft for Kvichak Bay (Middle Bluff), the Naknek River entrance and Kvichak, respectively. Tidal currents are 2.5 and 1.7 knots at flood stage and 2.5 and 3.0 knots at ebb stage at Naknek River and Kvichak River.[11]

Ice - Ice begins to form in the bay in November; the average date of freezeup is November 17, the earliest October 17, and the latest December 15. Ice breakup occurs around April 9; the earliest date was March 19 and the latest was April 25. During January and February the ice coverage is consolidated or fast.[4][11]

Offshore sea conditions and weather are available from SSMO Volume 14, Area 11 - Bristol Bay. See Port Moller for summary.

Local Flying Weather

Local flight weather data for the King Salmon Airport are presented in Table 5-14.

Generally, 25 to 29 days a month have favorable local flying weather conditions with slightly less favorable weather during the summer, presumably due to fog and low cloud conditions. Hourly data show that the hours between 00 and 08 during the summer have lower ceilings and visibilities than during the afternoon hours. This diurnal trend is not as apparent during the winter months.

Strong winds are not factored into these statistics and could decrease favorable flying weather by another few percent, especially during the winter, spring, and fall.

TABLE 5-14

KING SALMON - FLYING WEATHER

Average Frequency (%) When Ceiling ≤ 300 Ft and Visibility ≤ 1 Mi (based on 12 yrs of data)

Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
2.7	1.9	2.0	1.7	2.0	3.6	4.2	4.0	1.7	1.8	3.9	4.3

Mean Number of Days Ceiling ≥ 1,000 Ft and Visibility ≥ 3 Mi (based on 12 yrs of data)

Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
27.6	24.4	27.4	26.9	28.2	25.4	24.8	25.0	27.5	29.0	26.2	26.8

5.1.8 Offshore Nome

Local Nome Weather

Weather observations are taken at the Nome airport which lies near low and marshy flats. The ground along the coastal flats is swampy during the summer months but is permanently frozen below a depth of 2 to 3 ft. A series of foothills with heights of 500 to 1,200 ft extend from northwest through north to east at a distance of 4 to 8 miles. At a distance of 30 miles farther north, the Kigluaik Mountains reach a height of 5,000 ft.

The Norton Sound region is in the transitional climatic zone. Since the sound is completely frozen during the winter, the moderating influence of the open water is mostly effective from early June to about the middle of November. Means and extremes for Nome are presented in Table 5-15.

Temperatures

Normal monthly mean temperatures range from 4.4°F in January to 49.5°F in July. The record low is -47°F and the record high is 86°F. Mean number of days 0°F and below is 86.

Temperatures generally remain well below freezing from the middle of November to the latter part of April. In spite of the low temperatures, a short period of warmer temperatures is experienced in January where the maximum temperatures are often above freezing -- the "January thaw" singularity.

Precipitation

Measurable precipitation is observed on an average of 127 days per year. The annual precipitation varies from 9-25 in. and the maximum precipitation occurs during July,

TABLE 5-15

NORMALS, MEANS, AND EXTREMES OF WEATHER FOR NOME

Temperature, heating degree days

Month	Normal: Daily maximum	Normal: Daily minimum	Normal: Monthly	Extremes: Record highest	Year	Extremes: Record lowest	Year	Normal heating degree days (Base 65°)
(a)	(b)	(b)	(b)	6		6		(b)
J	11.5	-2.7	4.4	36	1968	-40	1971	1879
F	13.3	-2.4	5.5	47	1970	-42	1971	1666
M	16.3	-.5	7.9	38	1970	-46	1971	1770
A	28.4	13.9	21.2	42	1969	-30	1968	1314
M	41.2	28.8	35.0	75	1969	-2	1968	930
J	52.4	39.3	45.9	79	1969	25	1968	573
J	54.8	44.4	49.5	86	1968	32	1972	481
A	54.2	43.8	49.0	79	1967	27	1966	496
S	47.8	35.9	41.9	65	1968	15	1970	693
O	35.4	24.0	29.7	55	1969	-10	1966	1094
N	22.6	10.3	16.5	37	1967	-24	1968+	1455
D	12.9	-.4	6.3	43	1969	-34	1970+	1820
YR	32.6	19.5	26.1	86	JUL. 1968	-46	MAR. 1971	14171

Precipitation

Month	Normal total	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs	Year	Snow, Ice pellets: Mean total	Maximum monthly	Year	Maximum in 24 hrs	Year
(a)	(b)	26		26		26		26	26		26	
J	1.02	2.10	1957	T	1970	1.23	1963	9.2	23.7	1950	7.8	1947
F	0.94	1.46	1966	T	1972+	0.52	1950	5.7	17.8	1951	4.7	1951
M	0.80	1.99	1954	T	1971+	0.65	1954	7.5	19.7	1954	5.0	1948
A	0.80	2.15	1961	0.02	1969	0.56	1961	6.7	23.3	1961	6.3	1961
M	0.69	1.28	1952	0.12	1966	0.70	1948	1.9	9.8	1952	5.3	1952
J	0.93	3.04	1953	0.04	1964	2.03	1953	0.1	0.9	1948	0.9	1948
J	2.29	4.23	1954	0.25	1964	1.77	1954	0.0	0.0		0.0	
A	3.80	7.02	1951	0.40	1971	2.38	1956	T	0.1	1965	0.1	1965
S	2.67	5.72	1964	0.39	1968	1.28	1964	0.4	3.1	1958	2.6	1948
O	1.71	3.84	1972	0.02	1953	2.28	1957	4.8	13.6	1958	6.6	1948
N	1.16	2.53	1950	0.03	1962	0.79	1972	9.9	25.9	1970	7.6	1972
D	0.99	2.16	1951	0.03	1956	1.09	1951	7.5	22.3	1951	8.4	1951
YR	17.80	7.02	AUG. 1951	T	FEB. 1972+	2.38	AUG. 1956	53.7	25.9	NOV. 1970	8.4	DEC. 1951

Relative humidity, wind, sunshine, sky cover

Month	Relative humidity: Hour 01 (Local time)	Hour 07	Hour 13	Hour 19	Wind: Mean speed	Prevailing direction	Fastest mile: Speed	Direction	Year	Pct. of possible sunshine	Mean sky cover, sunrise to sunset
(a)	6	6	6	6	25	19	19	19		24	26
J	[illegible]	[illegible]	[illegible]	70	11.0	E	54	09	1967	36	6.3
F	[illegible]	[illegible]	[illegible]	67	11.4	NE	51	04	1971	50	5.5
M	[illegible]	[illegible]	[illegible]	71	10.5	E	44	08	1964	51	6.0
A	[illegible]	[illegible]	[illegible]	72	11.0	N	45	05	1964	50	6.4
M	[illegible]	[illegible]	[illegible]	70	10.4	N	44	09	1966	45	6.8
J	[illegible]	[illegible]	[illegible]	66	10.1	WSW	35	04	1971	39	7.0
J	[illegible]	[illegible]	[illegible]	71	10.1	WSW	35	12	1965	32	8.0
A	[illegible]	[illegible]	[illegible]	70	10.0	SW	40	26	1964	28	8.3
S	[illegible]	[illegible]	[illegible]	68	11.3	N	44	23	1964	32	7.5
O	[illegible]	[illegible]	[illegible]	75	11.9	N	52	28	1960	32	7.1
N	[illegible]	[illegible]	[illegible]	72	12.3	N	55	24	1965	28	7.2
D	[illegible]	[illegible]	[illegible]	69	10.4	E	54	05	1958	34	6.1
YR	[illegible]	[illegible]	[illegible]	70	11.0	N	55	24	NOV. 1965	38	6.8

Mean number of days

Month	Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog	Temperatures Max: 90° and above ‡	Max: 32° and below	Min: 32° and below	Min: 0° and below	Average daily solar radiation - langleys
(a)	26	26	26	26	26	26	26	6	6	6	6	
J	9	5	17	10	2	0	2	0	30	31	16	
F	11	5	14	9	2	0	1	0	27	28	16	
M	11	5	15	10	3	0	2	0	30	31	17	
A	9	6	15	10	2	0	2	0	22	30	[illegible]	
M	[illegible]	[illegible]	17	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	24	[illegible]	
J	[illegible]	[illegible]	16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	[illegible]	
J	[illegible]	[illegible]	22	13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
A	[illegible]	[illegible]	23	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
S	[illegible]	[illegible]	19	13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13	[illegible]	
O	[illegible]	[illegible]	19	10	1	[illegible]	[illegible]	[illegible]	12	25	[illegible]	
N	[illegible]	[illegible]	19	12	[illegible]	[illegible]	[illegible]	[illegible]	26	30	[illegible]	
D	10	4	17	9	3	0	2	0	27	31	16	
YR	84	68	213	127	17	*	25	0	170	249	66	

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Lowest temperature -47 in January 1919; maximum monthly precipitation 8.43 in July 1920; minimum monthly precipitation 0.00 in January 1917; maximum monthly snowfall 43.2 in January 1937; maximum snowfall in 24 hours 14.0 in February 1920.

(a) Length of record, years, based on January data. Other months may be for more or fewer years if there have been breaks in the record.
(b) Climatological standard normals (1941-1970).
* Less than one half.
\+ Also on earlier dates, months, or years.
T Trace, an amount too small to measure.
Below zero temperatures are preceded by a minus sign. The prevailing direction for wind in the Normals, Means, and Extremes table is from records through 1963.
‡ ≥ 70° at Alaskan stations.

Unless otherwise indicated, dimensional units used in this bulletin are: temperature in degrees F.; precipitation, including snowfall, in inches; wind movement in miles per hour; and relative humidity in percent. Heating degree day totals are the sums of negative departures of average daily temperatures from 65° F. Cooling degree day totals are the sums of positive departures of average daily temperatures from 65° F. Sleet was included in snowfall totals beginning with July 1948. The term "Ice pellets" includes solid grains of ice (sleet) and particles consisting of snow pellets encased in a thin layer of ice. Heavy fog reduces visibility to 1/4 mile or less.

Sky cover is expressed in a range of 0 for no clouds or obscuring phenomena to 10 for complete sky cover. The number of clear days is based on average cloudiness 0-3, partly cloudy days 4-7, and cloudy days 8-10 tenths.

Solar radiation data are the averages of direct and diffuse radiation on a horizontal surface. The langley denotes one gram calorie per square centimeter.

& Figures instead of letters in a direction column indicate direction in tens of degrees from true North; i.e., 09 - East, 18 - South, 27 - West, 36 - North, and 00 - Calm. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. If figures appear in the direction column under "Fastest mile" the corresponding speeds are fastest observed 1-minute values.

Source: Environmental Data Service (NOAA)

August, and September. Maximum in 24 hrs has been 2.4 in.

Seasonal snowfall averages about 54 in. and maximum depth on the ground has reached 74 in. Maximum snowfall in 24 hrs has been 8.4 in. The snow cover decreases rapidly in April and May and normally disappears by the middle of June.

Winds

During the summer months, the prevailing wind is from the southwest and during the remainder of the year, from north through east. Storms with southwest winds have caused waves in excess of the tide. A level of 14 ft above mean lower low water has been noted due to storms.[4]

In the winter months the majority of cyclonic storms take a path south of Nome, resulting in strong easterly winds accompanied by frequent blizzards, with the winds later becoming northerly and reaching Nome across the colder frozen areas of northern Alaska.

Average monthly wind speeds range from 9-11 knots. In severe windstorms speeds over 61 knots have been recorded several times. Blowing snow conditions severely hinder transportation in the area.

Cloudiness and Fog

Mean number of cloudy days is over 200 and the mean cloud coverage varies from six to eight-tenths. Storms moving through the region during summer result in extended periods of cloudiness and rain.

Frequency of heavy fog reaches a maximum in May, June, and July. Mean number of days a year for heavy fog occurrence is 25.

Offshore Sea Conditions and Marine Weather

Local Sea and Ice Conditions

Tides - The diurnal range of the tide of 1.6 ft but water levels are more strongly influenced by the wind than by the tide. An offshore wind may cause a level of 2 to 3 ft below mean lower low water for days at a time.[4] Maximum high tide is 1.9 ft and maximum low tide is 0.5 ft.[17] Tidal current averages about 1 knot.

Ice - Ice begins to form in Norton Sound in October and November; the average date of freezeup is November 12. The earliest is October 13 and the latest is December 13. Ice breakup occurs around May 29; the earliest date has been April 28 and the latest date has been June 28. Navigation is difficult due to ice from early December to early June and is usually suspended from late December to mid-May.[4]

Offshore sea conditions and weather are available from SSMO Volume 15, Area 16 - St. Lawrence.[18] The data are summarized for all of Norton Sound and are only available from February to September. The information may not be completely representative of conditions near Nome.

Sea Temperatures

During February, March and April sea temperatures range from 29°F and lower and during July and August have ranged from 31°F to 64°F. However, the most frequent temperature range has been from 41°F to 50°F during the summer months.

Sea Heights

The most frequent sea height is between < 1 ft and 4 ft. Sea waves have been reported between 17-19 ft during winds of 17-26 knots. However, waves of higher heights have probably occurred without being officially recorded.

Fogs

Statistics on fog occurrence are only available from February to September. Of a total of 4,715 observations taken, 879 noted the presence of fog, resulting in an 18.6% frequency. Fog occurs in each month, with maximum frequency during the summer months.

Local Flying Weather

Local flight weather statistics from the Nome Airport are presented in Table 5-16. Generally, flying conditions are more favorable in the fall months and more unfavorable during the summer and late winter. Blizzards, which occur during the winter period, are a real hazard to all modes of transportation.

TABLE 5-16

NOME - FLYING WEATHER

Average Frequency (%) When Ceiling ≤ 300 Ft and Visibility ≤ 1 Mi

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
8.0	5.7	5.8	4.2	2.2	5.8	3.0	2.6	1.1	1.5	5.1	4.6

Mean Number of Days Ceiling ≥ 1,000 Ft and Visibility ≥ 3 Mi

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
25.3	24.0	26.4	24.8	27.4	23.4	22.4	22.7	26.5	27.9	24.8	26.9

5.1.9 Offshore Cape Blossom (Kotzebue Sound)

Local Kotzebue Weather

Weather data are available from the airport at Kotzebue which is about 11 miles north of Cape Blossom and on the outer south side of the Hotham Inlet entrance. Most of the coastal plain is low and rolling tundra cut by numerous streams and lakes. Permafrost exists under the tundra.

The climate of Kotzebue Sound is of the Arctic type. The sound produces a maritime type of climate when the water is ice-free, which is approximately late May to late October. During the ice-free period cloudy skies prevail, fog is frequent, daily temperatures are relatively uniform and relative humidity is high. When the water surrounding the region starts to freeze, the climate becomes progressively more continental in character. These normal conditions are altered by cyclonic storms. Means and extremes for Kotzebue are shown in Table 5-17.

Temperature

Normal monthly temperatures range from -5.7°F in January to 52.7°F in July. The record low is -58°F and the record high is 85°F. Mean number of days 0°F and below is 119.

Like the North Slope, the temperature regime exhibits a modified maritime pattern when the winds are blowing onshore and continental characteristics when the winds are offshore.

Precipitation

Measurable precipitation is observed around 110 days a year, on the average. The annual precipitation varies from 5-14 in. and the maximum precipitation occurs during July, August and September.

TABLE 5-17

NORMALS, MEANS, AND EXTREMES FOR KOTZEBUE

Month	Temperature: Normal: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	Normal heating degree days (Base 65°)	Precipitation: Normal total	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs	Year
(a)	(b)	(b)	(b)	30		30		(b)	(b)	30		30		30	
J	1.3	-12.7	-5.7	39	1961	-47	1958	2192	0.34	1.01	1963	T	1966	0.81	1963
F	3.2	-11.2	-4.0	35	1944	-52	1968+	1932	0.30	1.13	1951	0.01	1946	0.68	1951
M	6.7	-10.9	-2.1	38	1961	-48	1956	2080	0.28	1.23	1956	T	1960+	0.47	1956
A	22.7	3.7	13.2	46	1969+	-44	1943	1554	0.31	1.34	1948	T	1943	0.36	1972
M	37.6	24.2	30.9	74	1947	-18	1945	1057	0.33	0.94	1968	0.03	1954	0.56	1965
J	50.0	37.6	43.8	83	1971	20	1948	636	0.49	1.32	1953	0.01	1956	0.80	1953
J	58.6	46.8	52.7	85	1958	34	1964+	381	1.46	2.98	1971	0.45	1964	1.78	1946
A	55.7	45.4	50.6	80	1968	31	1948	446	2.16	5.18	1951	2.38	1971	1.68	1954
S	45.9	35.8	40.9	68	1963	13	1970	723	1.22	2.85	1960	0.03	1967	0.94	1960
O	29.6	19.8	24.7	51	1950	-13	1970	1249	0.59	1.53	1960	0.04	1954	0.54	1960
N	12.9	1.9	7.4	38	1949	-36	1948	1728	0.36	0.98	1950	0.09	1968	0.26	1949
D	2.6	-9.8	-3.6	36	1970+	-47	1961+	2127	0.29	0.79	1965	0.02	1956	0.40	1944
YR	27.2	14.2	20.7	85	JUL. 1958	-52	FEB. 1968+	16105	8.18	5.18	AUG. 1951	T	JAN. 1966+	1.78	JUL. 1946

Month	Snow, Ice pellets: Mean total	Maximum monthly	Year	Maximum in 24 hrs	Year	Relative humidity: Hour 01	Hour 07	Hour 13	Hour [illegible] (Local time)
(a)	29	29		29		29	29	29	29
J	5.6	20.3	1957	4.7	1964	71	71	71	[illegible]
F	5.2	14.0	1956	6.0	1951	72	71	72	[illegible]
M	5.0	21.9	1954	8.6	1954	72	72	72	[illegible]
A	5.3	18.1	1967	4.6	1972	78	78	76	[illegible]
M	1.8	12.0	1964	3.9	1964	86	82	79	[illegible]
J	0.2	2.4	1963	2.1	1963	89	85	79	[illegible]
J	T	0.1	1959	0.1	1959	87	85	77	[illegible]
A	T	0.3	1962	0.3	1962	89	87	78	[illegible]
S	1.1	7.4	1957	5.0	1960	87	86	74	[illegible]
O	6.7	18.6	1971	6.0	1944	83	83	78	[illegible]
N	8.1	17.1	1964+	6.3	1954	76	77	76	[illegible]
D	7.0	19.3	1965	7.5	1957	72	72	72	[illegible]
YR	46.0	21.9	MAR. 1954	8.6	MAR. 1954	80	79	76	[illegible]

Month	Mean number of days: Temperatures: Max [illegible]	Min 32° and below	Min 0° and below
(a)	29	29	29
J	30	31	23
F	28	28	24
M	30	31	23
A	25	30	14
M	[illegible]	26	[illegible]
J	[illegible]	[illegible]	[illegible]
J	[illegible]	[illegible]	[illegible]
A	[illegible]	[illegible]	[illegible]
S	[illegible]	[illegible]	[illegible]
O	20	29	[illegible]
N	29	30	13
D	30	31	22
YR	201	291	119

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows:
Lowest temperature -58 in March 1930; maximum monthly snowfall 60.5 in January 1937.

(a) Length of record, years, based on January data. Other months may be for more or fewer years if there have been breaks in the record.
(b) Climatological standard normals (1931-1960).
* Less than one half.
\+ Also on earlier dates, months, or years.
T Trace, an amount too small to measure.
Below zero temperatures are preceded by a minus sign.
The prevailing direction for wind in the Normals, Means, and Extremes table is from records through 1963.
§ ≥ 70° at Alaskan stations.

[illegible]

& Figures instead of letters in a direction column indicate direction in tens of degrees from true North, i.e., 09 - East, 18 - South, 27 - West, 36 - North, and 00 - Calm. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. If figures appear in the direction column under "Fastest mile" the corresponding speeds are fastest observed 1-minute values.

Source: Environmental Data Service (NOAA)

Seasonal snowfall averages about 47 in. Maximum snowfall in 24 hrs has been 8.6 in. Snow occurs in every month of the year.

Winds

Winds prevail from the west during summer and from east or northeast during winter. Cyclonic storms are frequent, especially from October to April, and many of these are accompanied by high winds and blizzard conditions during the winter months. The absence of pronounced sheltering terrain results in unimpeded air movement throughout the year.

Average monthly wind speeds range from 10-13 knots. In severe windstorms, easterly winds of over 78 knots have been observed a number of times. During the summer, westerly winds above 43 knots have been recorded.

Cloudiness and Fog

Mean number of cloudy days is around 200 and the mean cloud coverage varies from six to eight-tenths.

The frequency of heavy fog reaches a maximum in early summer - May, June, and July. Mean number of days a year of heavy fog occurrence is 20.

Terrestrial Refraction

Abnormal refraction is a common occurrence in this region; frost mounds (pingos) may loom like mountains and landmarks may be sighted much farther from shore than the normal limit of visibility would permit.[4]

Offshore Sea Conditions and Marine Weather

Local Sea and Ice Conditions

Tides - The tidal range is on the order of 2 ft. The average velocity of the tidal current is about 0.5

knot at the anchorage southwest of Cape Blossom; the flood sets southeastward and the ebb northwestward. A northwestward nontidal flow sometimes has sufficient velocity to overcome the flood of tidal current. This northwestward flow attains maximum velocities of 1 to 2 knots at the time of the tidal current's ebb strength.[4]

Ice - Average freezeup in Kotzebue Sound is around October 23. The earliest date has been October 2 and the latest November 5. Average date of breakup is May 31; the earliest date has been May 17 and the latest June 8. Navigation is difficult from late October to the latter part of June and is usually suspended from the second week in November to mid-June.[4]

Offshore sea conditions are available from SSMO Volume 15, Area 17 - Cape Lisburne.[19] The data are for the complete area from the coast to 170W from May through September. At times, the data may not be totally representative of local conditions at Cape Blossom.

Sea Temperatures

During May and June sea temperatures are quite frequently around 29/30°F. The range is 29°F to 44°F. During July, August and September temperatures may range from 29°F to 60°F but are most frequently between 39°F and 48°F.

Sea Heights

The most frequent sea height is between <1 ft and 4 ft. Waves to 17-19 ft have been reported with winds above 50 knots.

Fog

A total of 2,239 observations have been taken during the May-September period. Approximately 495 observations, or 22%, noted the presence of fog. Percentages of fog occurrence vary from 12-30% from month to month.

Local Flying Weather

Local flight weather statistics are available from the Kotzebue airport and are presented in Table 5-18. Like Nome, flying conditions are more favorable during the fall. Summer low cloudiness and fog conditions tend to improve in the afternoons. During the winter, blizzards are a real hazard to all modes of transportation.

TABLE 5-18

KOTZEBUE - FLYING WEATHER

Average Frequency (%) When Ceiling $\leq$ 300 Ft and Visibility $\leq$ 1 Mi (based on 12 yrs of data)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
5.8	7.6	4.1	3.9	3.6	5.1	2.7	1.0	0.5	2.1	4.5	3.9

Mean Number of Days Ceiling $\geq$ 1,000 Ft and Visibility $\geq$ 3 Mi (based on 12 yrs of data)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
26.3	23.5	27.4	26.6	27.1	25.7	26.8	27.0	27.8	28.2	26.3	27.1

5.1.10 and 5.1.11 Prudhoe Bay (Offshore and Onshore)

Local Prudhoe Bay Weather

Prudhoe Bay is located on the shore of the Arctic Coastal Plain, a smooth plain rising from the Arctic Ocean. In some places pingos are sufficiently abundant to give an undulating skyline. The coastal plain is very poorly drained and consequently is very marshy in summer. The entire land area is underlain by permafrost 1,000 to 2,000 ft thick. A network of ice-wedge polygons covers most of the coastal plain.[20]

Weather observations from Prudhoe Bay are available only for three years. The nearest station with a long history of observations is Barter Island, approximately 100 miles to the east. Tables 5-19 and 5-20 give the available data for Prudhoe Bay and Barter Island.

The climate of Prudhoe Bay is classified as Arctic maritime. The general climatic conditions are characterized by cold temperatures (both winter and summer), small annual precipitation amounts, and strong winds over the coastal plains. These winds result in equivalent chill temperatures many degrees colder than the actual temperature.

Temperatures

The sun is continuously below the horizon from mid-November to about mid-January and continuously above the horizon from mid-May to the first of August. Since the long-wave radiation dominates the radiation balance during much of the year, air temperatures remain below the freezing point through most of the year.

Normal monthly temperatures are near -20°F during the winter and in the 40s°F during the summer. The record low

TABLE 5-19

MEANS AND EXTREMES FOR PRUDHOE BAY

Month	Temperature: Normal: Daily Maximum	Temperature: Normal: Daily minimum	Temperature: Normal: Monthly	Temperature: Extremes: Record highest	Year	Record lowest	Year	Normal heating degree days (Base 65°)	Precipitation: Normal total	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Ice pellets: Mean total	Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity: Hour 02 (Local time)	Hour 08	Hour 14	Hour 20	Wind: Mean speed	Prevailing direction	Fastest mile: Speed	Direction	Year	Pct of possible sunshine	Mean sky cover sunrise to sunset
(b)	(b)	(b)	(b)	3		3		(b)	(b)	0		0		0																	
J	-13.2	-27.7	-20.5	32	1973	-48	1971			0.00		0.00		0.00			0.0		0.0												
F	-18.9	-33.0	-26.0	24	1973	-58	1972			0.00		0.00		0.00			0.0		0.0												
M	-16.2	-31.7	-24.0	8	1973+	-52	1973+			0.00		0.00		0.00			0.0		0.0												
A	2.5	-15.7	-6.6	20	1971	-34	1971			0.00		0.00		0.00			0.0		0.0												
M	26.5	14.1	20.3	47	1971	-18	1971			0.00		0.00		0.00			0.0		0.0												
J	43.6	32.9	38.3	58	1971	24	1972			0.00		0.00		0.00			0.0		0.0												
J	52.8	38.2	45.5	75	1971	30	1971			0.00		0.00		0.00			0.0		0.0												
A	46.6	35.7	41.2	68	1971	27	1971			0.00		0.00		0.00			0.0		0.0												
S	36.0	27.8	31.9	53	1972	15	1972			0.00		0.00		0.00			0.0		0.0												
O	16.5	3.0	9.8	37	1972	-23	1970			0.00		0.00		0.00			0.0		0.0												
N	4.5	-3.5	-2.0	26	1970	-36	1971			0.00		0.00		0.00			0.0		0.0												
D	-7.2	-20.0	-13.6	34	1972	-49	1971			0.00		0.00		0.00			0.0		0.0												
YR	14.5	1.3	7.9	75	JUL. 1971	-58	FEB. 1972		0.00	0.00	0000+	0.00	DEC. +	0.00	0000+		0.0		0.0												

Source: Environmental Data Service (NOAA)

TABLE 5-20

NORMALS, MEANS, AND EXTREMES FOR BARTER ISLAND

Temperature and heating degree days

Month	Normal: Daily maximum	Normal: Daily minimum	Normal: Monthly	Extremes: Record highest	Year	Extremes: Record lowest	Year	Normal heating degree days (Base 65°)
(a)	(b)	(b)	(b)	23		25		(b)
J	-9.9	-23.6	-16.8	39	1962	-51	1962	2336
F	-13.3	-25.9	-19.6	34	1962+	-59	1950	2369
M	-7.7	-22.1	-14.9	36	1967	-50	1961	2477
A	8.6	-6.8	.9	43	1958	-38	1971	1923
M	25.9	13.5	20.7	52	1964	-16	1964	1373
J	39.1	29.3	34.2	67	1961	15	1965	924
J	47.5	35.0	41.2	75	1967	24	1967	735
A	45.2	34.7	40.0	72	1957	24	1971+	775
S	36.0	28.2	32.1	64	1950	4	1970	987
O	22.6	11.7	17.2	46	1969	-23	1970	1482
N	6.5	-6.1	.2	37	1950	-51	1968	1944
D	-3.7	-17.1	-10.4	35	1963	-51	1961	2337
YR	16.4	4.4	10.4	75	JUL. 1967	-59	FEB. 1950	19862

Precipitation

Month	Normal total	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs	Year	Snow, Ice pellets: Mean total	Maximum monthly	Year	Maximum in 24 hrs	Year
(a)	(b)	24		24		24		24	24		24	
J	0.40	4.00	1962	0.01	1959	2.23	1962	5.9	35.0	1962	14.0	1962
F	0.35	2.53	1955	T	1968+	1.22	1955	3.1	15.3	1959	3.8	1970
M	0.20	1.44	1967	T	1968+	0.55	1967	2.9	15.0	1967	5.5	1967
A	0.17	1.28	1963	T	1968	0.44	1963	2.5	12.2	1963	4.4	1963
M	0.25	1.51	1967	T	1968	0.76	1954	3.1	11.1	1954	7.0	1954
J	0.51	2.09	1956	0.06	1969	1.15	1956	1.5	7.2	1968	5.1	1960
J	0.88	3.01	1971	0.15	1958	1.04	1971	0.4	2.5	1959	2.2	1964
A	1.05	3.40	1955	0.16	1958	1.11	1955	1.5	7.4	1969+	3.4	1956
S	0.94	4.91	1954	0.07	1969	2.23	1954	6.3	35.0	1954	17.0	1954
O	0.84	3.62	1954	0.12	1969	1.98	1954	9.5	32.1	1954	16.0	1954
N	0.40	1.50	1950	0.04	1960	0.43	1956	5.6	14.9	1950	5.0	1967
D	0.29	1.17	1949	T	1960	0.55	1949	3.7	12.9	1965	5.2	1949
YR	6.28	4.91	SEP. 1954	T	APR. 1968+	2.23	JAN. 1962	46.0	35.0	SEP. 1954	17.0	SEP. 1954

Relative humidity, wind and sunshine

Month	Relative humidity: Hour 02 (Local time)	Hour 08	Hour 14	Hour 20	Wind &: Mean speed	Prevailing direction	Fastest mile: Speed	Direction	Year	Pct of possible sunshine	Mean sky cover sunrise to sunset
(a)	25	25	25	25	23	19	16	16			24
J	68	68	68	68	14.3	W	75	23	1957		#
F	67	67	67	68	14.1	W	62	27	1962		5.3
M	67	67	68	67	13.6	W	77	28	1969		5.7
A	74	74	75	75	12.2	W	52	27	1963		6.1
M	87	86	84	86	12.3	E	55	26	1968		8.3
J	92	89	87	90	11.3	ENE	50	27	1970+		7.8
J	92	89	86	89	10.6	ENE	40	25	1963		7.8
A	94	91	88	92	11.7	E	44	27	1969+		8.6
S	92	90	88	91	13.1	E	78	27	1957		8.6
O	84	84	83	84	14.4	E	58	27	1963		8.3
N	75	74	74	74	14.9	E	81	26	1970		#
D	68	68	69	68	14.0	E	72	27	1961		#
YR	80	79	78	79	13.0	E	81	26	NOV. 1970		

Mean number of days

Month	Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog	Temperatures Max: 90° and above §	Max: 32° and below	Min: 32° and below	Min: 0° and below	Average daily solar radiation - langleys
(a)	24	24	24	23	24	23	24	25	25	25	25	
J	3	3	8	6	2	0	2	0	31	31	29	
F	10	6	12	5	1	0	1	0	28	28	28	
M	10	8	13	5	1	0	1	0	31	31	30	
A	8	8	14	6	1	0	1	0	29	30	23	
M	3	5	23	7	1	0	7	0	24	31	3	
J	3	7	20	6	*	0	12	0	4	23	0	
J	3	9	19	9	*	0	13	0	0	9	0	
A	1	7	23	11	1	0	16	0	1	11	0	
S	2	4	24	10	2	0	10	0	11	25	0	
O	2	5	24	13	3	0	4	0	29	31	7	
N	4	4	15	6	2	0	3	0	30	30	20	
D	#	#	#	6	1	0	1	0	31	31	29	
YR	49	64	195	92	13	0	74	0	249	311	167	

May-December 1948 data considered in extracting extremes of monthly precipitation.
Sun below horizon continuously November 24 to January 17.
Yearly totals of data entered in columns headed "Clear, Partly Cloudy and Cloudy" in both tables are for period sun above horizon.

(a) Length of record, years, based on January data. Other months may be for more or fewer years if there have been breaks in the record.
(b) Climatological standard normals (1941-1970).
* Less than one half.
\+ Also on earlier dates, months, or years.
T Trace, an amount too small to measure.
Below zero temperatures are preceded by a minus sign.
The prevailing direction for wind in the Normals, Means, and Extremes table is from records through 1963.
§ 70° at Alaskan stations.

Unless otherwise indicated, dimensional units used in this bulletin are: temperature in degrees F.; precipitation, including snowfall, in inches; wind movement in miles per hour; and relative humidity in percent. Heating degree day totals are the sums of negative departures of average daily temperatures from 65° F. Cooling degree day totals are the sums of positive departures of average daily temperatures from 65° F. Sleet was included in snowfall totals beginning with July 1948. The term "ice pellets" includes solid grains of ice (sleet) and particles consisting of snow pellets encased in a thin layer of ice. Heavy fog reduces visibility to 1/4 mile or less.

Sky cover is expressed in a range of 0 for no clouds or obscuring phenomena to 10 for complete sky cover. The number of clear days is based on average cloudiness 0-3, partly cloudy days 4-7, and cloudy days 8-10 tenths.

Solar radiation data are the averages of direct and diffuse radiation on a horizontal surface. The langley denotes one gram calorie per square centimeter.

& Figures instead of letters in a direction column indicate direction in tens of degrees from true North; i.e., 09 - East, 18 - South, 27 - West, 36 - North, and 00 - Calm. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. If figures appear in the direction column under "Fastest mile" the corresponding speeds are fastest observed 1-minute values.

Source: Environmental Data Service (NOAA)

to date is -58°F and the record high is 75°F. About 167 days, on the average, have temperatures of 0°F and below.

Precipitation

As a result of the low average temperatures, there is little precipitation; the annual mean may vary between 4 and 16 in water equivalent. Measurable precipitation is recorded on about 100 days but because of strong winds the catch of precipitation is probably significantly less than actually occurs. Maximum precipitation occurs in the summer and the least in the spring. Maximum amount in 24 hrs has been around 2 in.

Snow covers the ground about eight months of the year and usually falls during every month. However, most of the July and August precipitation is in the form of rain.

Winds

One of the most significant features of surface winds in the Arctic coastal region is the persistence factor; a calm condition along the coast prevails between 0.3 and 6% of the time.

Wind speeds may be very high either with west or east winds. Monthly mean winds range from 10 to 13 knots and speeds up to 70 knots have been observed. These persistent high winds result in serious operational problems by creating shifting snow drifts, low visibility in blowing snow and hazardous wind chill factors.

Cloudiness and Fog

Much of the North Slope is cloudy due to the prevailing easterly wind off the Arctic Ocean. The amount of solar radiation appears to have a direct relationship to the

occurrence of cloudiness, precipitation and heavy fog over the North Slope. Cloudy skies are very frequent during summer and fall with the mean daytime sky cover showing little variance from eight-tenths. Cloud types are mainly low stratus and fog; cumuli and thunderstorms are very infrequent.

Dense fog occurs on an average of 30 to 100 days a year, most frequently during the summer months. Ice fog episodes are relatively common during winter, averaging 3 to 7 days a month.

Freeze-Thaw Cycle

A definite seasonal freeze-thaw cycle of the tundra or water-saturated marshes of the North Slope is evident during the year. Searby[21][22] has provided mean dates for the freeze and thaw season at Barter Island. The average start date of the freeze season is 6 September and the average length of freeze season is 289 days. The average start date of the thaw season is 22 June and the average length of the thaw season is 76 days.

The average start date of the freeze-up period shows little variation from season to season but the start of thaw season is much more variable.

Wind-Chill Factor

The high persistent wind speeds along the North Slope create a persistent equivalent chill temperature that is a serious hazard for all outdoor activities during the coldest months. For example, at Barter Island in February the mean daily maximum and minimum are -13°F and -26°F and the mean wind is around 12 knots (14 mph). An average equivalent chill temperature can be estimated from Table 5-21 and may range from -50°F to -65°F. Extreme conditions give even lower chill temperatures.

TABLE 5-21

EQUIVALENT WIND CHILL TEMPERATURES

WIND SPEED		COOLING POWER OF WIND EXPRESSED AS "EQUIVALENT CHILL TEMPERATURE"																				
KNOTS	MPH	TEMPERATURE (°F)																				
CALM	CALM	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60
		EQUIVALENT CHILL TEMPERATURE																				
3-6	5	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-65	-70
7-10	10	30	20	15	10	5	0	-10	-15	-20	-25	-35	-40	-45	-50	-60	-65	-70	-75	-80	-90	-95
11-15	15	25	15	10	0	-5	-10	-20	-25	-30	-40	-45	-50	-60	-65	-70	-80	-85	-90	-100	-105	-110
16-19	20	20	10	5	0	-10	-15	-25	-30	-35	-45	-50	-60	-65	-75	-80	-85	-95	-100	-110	-115	-120
20-23	25	15	10	0	-5	-15	-20	-30	-35	-45	-50	-60	-65	-75	-80	-90	-95	-105	-110	-120	-125	-135
24-28	30	10	5	0	-10	-20	-25	-30	-40	-50	-55	-65	-70	-80	-85	-95	-100	-110	-115	-125	-130	-140
29-32	35	10	5	-5	-10	-20	-30	-35	-40	-50	-60	-65	-75	-80	-90	-100	-105	-115	-120	-130	-135	-145
33-36	40	10	0	-5	-15	-20	-30	-35	-45	-55	-60	-70	-75	-85	-95	-100	-110	-115	-125	-130	-140	-150
WINDS ABOVE 40 HAVE LITTLE ADDITIONAL EFFECT		LITTLE DANGER					INCREASING DANGER (Flesh may freeze within 1 minute)							GREAT DANGER (Flesh may freeze within 30 seconds)								
		DANGER OF FREEZING EXPOSED FLESH FOR PROPERLY CLOTHED PERSONS																				

During periods of extreme cold, winds of 10-12 knots are unusual but a man walking or riding in a vehicle can produce a lower equivalent temperature.

Offshore Sea and Ice Conditions

Local Sea and Ice Conditions

Tides The local tidal range is on the order of one foot. However, nontidal components, such as wind or pressure fields, can cause changes in the sea level of as much as five feet over a period of a few days. Inshore currents are closely coupled with the wind.[4]

Ice The dates of appearance of ice in the fall varies greatly from year to year, but the break-up dates in early summer show smaller variance. Young ice begins to form around heavy ice about mid-September; by the end of the month it forms in open water and rapidly along the beach. By this time the main ice pack has moved close to shore. The pack breaks off from shore ice in the spring (May) and moves off and on until June. The movement of the pack, on and off, continues well into July, after which time heavily massed floe ice, much broken and heavily jammed together, may be expected.[4] In summer, the pack moves gradually northward and then returns again in late fall. However, the wind usually determines the movement of the ice pack.

Local Flying Weather

Table 5-22 presents data on local flying conditions for Barter Island. Additional information on North Slope flying weather conditions have been summarized by Searby[22] for several oil field "airports."

Generally, the most favorable season for flying is early spring. Winter operations are at times hazardous due to blizzards, whiteout, and ice fog. Summer operations are made more difficult by extensive cloudiness, intermittent precipitation, freezing rain, heavy coastal fog, and occasionally strong winds.

TABLE 5-22

BARTER ISLAND - FLYING WEATHER

Average Frequency (%) When Ceiling ≤ 300 Ft and Visibility ≤ 1 Mi (based on 12 yrs of data)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
14.3	17.2	11.8	9.1	12.1	14.2	16.5	20.6	17.7	10.0	12.2	9.6

Mean Number of Days Ceiling ≥ 1,000 Ft and Visibility ≥ 3 Mi

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
24.0	20.7	24.5	23.7	16.0	17.9	21.2	18.2	18.7	21.4	21.1	24.6

5.1.12 Umiat

Local Umiat Weather

Umiat lies in a shallow inland valley on the Colville River about 50 miles north of the Brooks Range and 75 miles south of the Arctic coast. The terrain is tundra underlain by extensive permafrost.

Weather observations are available from Umiat. These data have been utilized in a number of studies of the North Slope.[22][23]

The climate is predominately continental with some modification during the summer months when the marine influence is the strongest. Means and extremes for Umiat are shown in Table 5-23.

Temperatures

Monthly mean temperatures vary from -29.6°F in February to 53°F in July. Average diurnal range varies from 14° to 24°, a somewhat larger variance than sites on the coast experience (8° to 17°). The official record low is -63°F; however, a temperature of -78°F was reported on 14 January 1955. Record high has been 85°F.

Precipitation

The annual mean precipitation is around 6 in. but is probably more because of the inefficiency of gages during strong winds. Measurable precipitation is recorded on about 100 days. Maximum precipitation occurs in the summer (August) and the least in the spring. Maximum amount in 24 hrs has been 0.80 in.

A continuous snow cover generally forms by mid-September. Snow depths build slowly but steadily to a maximum of around 15-20 in. The snow cover clears away by mid-June. The mean total snowfall for the year is approximately 31 in. The maximum in 24 hrs has been 4.2 in.

Freezing rain occurs relatively frequently and is caused by the predominance of cold surface air while temperatures aloft are often above freezing during precipitation. This causes the rain to freeze when it strikes the surface. The hazard to flying aircraft and other modes of transportation is obvious.

TABLE 5-23

MEANS AND EXTREMES FOR UMIAT

Month	Temperature: Normal: Daily maximum	Normal: Daily minimum	Normal: Monthly	Extremes: Record highest	Year	Extremes: Record lowest	Year	Normal heating days (Base 65)	Precipitation: Normal total	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Ice pellets: Mean total	Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity: Hour 02 (Local time)	Hour 08	Hour 14	Hour 20	Wind: Mean speed	Prevailing direction	Fastest mile: Speed	Direction	Year	Pct of possible sunshine	Mean sky cover sunrise to sunset
a)	(b)	(b)	(b)	8		8		(b)	(b)	7		7		7		7	7		7												
J	-12.8	-30.9	-21.9	30	1950	-62	1951		0.31	0.88	1950	0.06	1948	0.24	1952	3.2	9.2	1950	2.4	1952											
F	-21.7	-37.5	-29.6	28	1948	-76	1955		0.19	0.49	1953	T	1947	0.30	1953	1.9	4.0	1953+	3.0	1953											
M	-7.2	-25.3	-16.3	35	1949	-52	1947		0.17	0.38	1954	T	1947	0.22	1954	2.0	3.8	1954	2.2	1954											
A	10.1	-11.4	-.7	40	1954+	-46	1952		0.32	1.50	1948	T	1953	0.34	1954	3.2	14.5	1948	4.2	1948											
M	27.1	13.2	20.2	55	1951	-22	1952		0.11	0.29	1954	T	1953+	0.19	1954	1.1	3.5	1949	1.9	1954											
J	50.8	34.7	42.8	74	1954	20	1949		0.54	1.25	1953	T	1947	0.39	1953	0.6	4.4	1948	2.1	1948											
J	63.2	42.7	53.0	85	1953+	30	1954		0.79	1.68	1951	0.14	1951	0.52	1951	T	T	1954+	T	1954+											
A	57.1	38.7	47.9	77	1951+	24	1952+		1.51	4.00	1947	0.05	1954	1.03	1947	0.5	2.0	1940	1.9	1953											
S	38.7	26.3	32.5	63	1950	-6	1948		0.52	0.86	1951	0.24	1947	0.35	1952	2.3	5.8	1952	3.3	1952											
O	19.6	4.9	12.2	45	1952	-27	1953		0.47	0.78	1947	0.14	1949	0.37	1947	5.8	7.9	1952	3.7	1947											
N	7.9	-8.4	-.3	43	1952	-53	1948		0.42	1.07	1950	0.15	1953+	0.27	1950	5.5	10.7	1950	2.7	1950											
D	-12.8	-27.6	-20.2	31	1951	-56	1948		0.38	0.66	1951	0.08	1948	0.24	1951	4.5	6.6	1951	2.4	1951											
YR	18.3	1.6	10.0	83	JUL. 1953+	-76	FEB. 1955		5.73	4.00	AUG. 1947	T	MAY 1953+	1.03	AUG. 1947	30.6	14.5	APR. 1948	4.2	APR. 1948											

Source: Environmental Data Service (NOAA)

Winds

Umiat experiences frequent easterlies during the summer but in winter Katabatic (westerly) winds prevail; in this case they blow down the valley from the west. An occasional storm from the west during winter will cause stronger westerlies. Speeds have exceeded 41 knots at times. However, calms are relatively frequent during the winter at Umiat (17% of the time).

Cloudiness and Fog

The mean sky cover varies from five-tenths in February to nearly nine-tenths in September. During summer and fall, overcast skies are very frequent.

In winter, the sky is usually either clear or completely covered. The approach and presence of a cloud layer is invariably marked by a rise in temperature and clearing is quickly followed by a fall in temperature. The temperature may rise 5 or 6°F before clouds appear and 15° or 20° after they arrive. This feature has long been used by arctic natives to forecast storms.[23]

Fog occurs in every month of the year and is slightly more frequent during the summer and fall months (∿5% of observations in October). Ice fog occurs in the winter time.

Freeze - Thaw Cycle

The Colville River normally breaks up about 24 May ± 12 days. On the average, it becomes unsafe to walk on the river about 17 May and safe to walk on it about 18 October.[23]

Local Flying Weather

Local flying weather data for Umiat are presented in Table 5-24. Additional information is discussed by Searby.[22]

TABLE 5-24

LOCAL FLYING WEATHER DATA FOR UMIAT

PERCENTAGE FREQUENCY OF OCCURRENCE

UMIAT

	CEILING HEIGHT					VISIBILITY						
	0-400 ft.	500-900 ft.	1000-2000 ft.	2100-3000 ft.	>3000 ft.	0-1/8 mi.	3/16-1/4 mi.	5/16-1/2 mi.	5/8-3/4 mi.	1-2 1/4 mi.	2 1/2 mi.	≥3 mi.
01	2.5	2.1	10.7	4.5	80.2	1.5	.6	1.0	.7	7.3	1.2	87.7
02	4.3	2.9	8.2	4.2	80.4	3.1	1.6	2.0	.8	8.5	1.0	83.0
03	.6	1.9	8.4	4.1	85.0	.2	.4	.8	.4	5.8	.9	91.5
04	2.2	6.3	13.4	5.6	72.5	1.1	.7	1.1	.6	6.8	.6	89.1
05	6.1	14.3	29.5	4.9	45.2	.7	.9	.6	.6	5.5	.4	91.3
06	4.7	11.3	24.0	8.7	51.3	.2	.5	.6	.3	3.4	.2	94.8
07	3.3	6.7	11.5	7.1	71.4	.4	.2	.4	.5	2.2	.3	96.0
08	3.5	10.4	17.5	10.2	58.4	.6	.5	.7	.6	2.8	.4	94.4
09	5.8	15.1	31.6	8.3	39.2	.4	.6	1.3	.7	6.1	.5	90.4
10	6.8	15.3	22.8	6.2	48.9	.8	1.0	2.6	1.3	8.3	.5	85.5
11	4.3	12.0	18.1	7.7	57.9	.8	1.7	2.5	1.1	9.6	.8	83.5
12	3.3	4.8	15.6	6.6	69.7	.7	1.2	1.9	.6	7.7	1.2	86.7
Yr	3.9	8.6	17.6	6.5	63.4	.8	.8	1.3	.7	6.1	.6	89.5

In winter, low ceilings are not as frequent as along the coast. However, the same hazards still exist. During summer extensive cloudiness prevails but visibility is usually good. Ceilings and visibility are generally the best from 10 a.m. to 22 p.m. in the summer. Thunderstorms are a little more frequent than observed on the coastal regions.

5.1.13 Yukon River Taps Crossing

Local Yukon River Taps Crossing Weather

The pipeline crosses the Yukon River southwest of Stevens Village and northeast of Rampart in a geological region called the Rampart Trough. The region consists of gently rolling topography, tundra vegetation, scattered thaw lakes, and permafrost.

One to three years of weather observations have been taken at three airports near the pipeline crossing; these are Livengood, Prospect Creek Camp, and Five Mile Camp. The Yukon River is five miles from Five Mile Camp. A longer record of climatic data is available from Rampart.[14]

The climate of this region is typical of a continental regime; i.e., cold winters, mild and occasionally warm summers and light surface winds. Means and extremes for Five Mile Camp are presented in Table 5-25.

Temperatures

Mean monthly temperatures during winter range from the -10s to -30s and the minimums have ranged from -80°F to -54°F. In the summer, mean monthly temperatures range from the 50s to 60s and the maximums have ranged from 87°F to 97°F.

TABLE 5-25

MEANS AND EXTREMES FOR FIVE MILE CAMP

Month	Temperature: Normal: Daily maximum	Temperature: Normal: Daily minimum	Temperature: Normal: Monthly	Temperature: Extremes: Record highest	Year	Record lowest	Year	Normal heating degree days (Base 65°)	Precipitation: Normal total	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Ice pellets: Mean total	Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity: Hour 02 (Local time)	Hour 08	Hour 14	Hour 20	Wind: Mean speed	Prevailing direction	Fastest mile: Speed	Direction	Year	Pct. of possible sunshine	Mean sky cover sunrise to sunset
(a)	(b)	(b)	(b)	1		1		(b)	(b)	1		1		1	1		1								3		3	3			3
J	-22.3	-35.1	-28.7	20	1972	-61	1972		0.01	T	1972	T	1972		1972	0.1	T	1972	T	1972					.0		6	S	1972		2.8
F	-1.6	-27.1	-14.4	29	1972	-50	1972		0.00	0.00	1972	0.00	1972	0.00	1972	0.0	0.0	1972	0.0	1972					1.6		29	NE	1972+		3.4
M		-30.2				-42	1972			0.00		0.00		0.00		12.5	12.5	1972	5.1	1972					3.1		29	E	1973		3.3
A	34.0	6.2	20.1	55	1971	-28	1971		0.53	0.53	1971	0.53	1971	0.28	1971	5.3	5.3	1971	2.6	1971					3.9		67	NW	1971		3.4
M	56.0	29.7	42.9	69	1971	7	1971		1.12	1.12	1971	1.12	1971	1.12	1971	0.0	0.0	1971	0.0	1971					2.8		29	NE	1971		3.9
J	75.8	44.1	60.0	90	1971	30	1971		2.60	2.60	1971	2.60	1971	0.90	1971	0.0	0.0	1971	0.0	1971					3.7		17	SSE	1971+		3.3
J	73.0	43.4	58.2	83	1971	34	1971		3.56	3.56	1971	3.56	1971	1.08	1971	0.0	0.0	1971	0.0	1971					1.7		12	W	1971+		5.0
A										0.00		0.00		0.00			0.0		0.0						1.8		17	N	1971		5.8
S	47.5	24.6	36.1	63	1971	-8	1970		0.80	1.09	1971	0.50	1970	0.28	1971	0.2	0.4	1971	0.4	1971					2.1		23	NNE	1971		6.1
O	22.5	4.5	13.5	40	1971+	-27	1970		0.60	1.00	1971	0.20	1970	0.25	1971	6.3	10.5	1971	3.0	1971					.9		12	NE	1971		7.3
N	2.5	-15.1	-6.3	20	1971	-40	1971		1.50	1.50	1971	1.50	1971	0.60	1971	15.0	15.0	1971	6.0	1971					.8		12	NE	1972		6.3
D	-7.2	-23.4	-15.3	19	1970	-59	1970			0.00		0.00		0.00		8.2	8.2	1971	1.3	1971					1.2		23	N	1972		4.6
YR	28.0	2.0	16.6		1972		1972		10.72		00000	0.00	FEB. 1972+		00000		15.0	NOV. 1971	6.0	NOV. 1971					11.8		67	NW	APR. 1971		4.6

Source: Environmental Data Service (NOAA)

Precipitation

The annual mean number of days with 0.01 in. or more of precipitation is around 80, which gives an annual mean precipitation of about 10 in. Most of the annual precipitation falls during late summer and fall months. The maximum 24-hr precipitation has been about 2 in.

Snow has occurred during all months except July. The total seasonal snowfall ranges from 50 to 60 in. The cold temperatures during winter cause much of the snowfall to remain on the ground. Maximum snowfall in 24 hrs has been around 6 to 10 in.

Winds

Prevailing winds are generally from the northerly direction, northwest through northeast. Mean speeds vary from calm to 6 knots. Strong winds are normally rare but wind speeds up to 58 knots have been observed. Some drifting of snow occurs, but not nearly as much as on the Arctic Slope.

During the summer, winds may prevail from the southerly directions at times.

Cloudiness and Fog

Mean sky cover varies from four-tenths in January to eight-tenths in July. In contrast to the Arctic Slope, thunderstorm activity is more frequent and probably accounts for much of the summer precipitation.

Data on fog occurrence are lacking but it probably occurs in the summer evenings and mornings and then dissipates during the late mornings. In winter, ice fogs occur near sources of moisture.

Freeze-Thaw Cycle

The average date for ice breakup on the Yukon River at Rampart is 16 May; the earliest date has been 1 May and the latest, 25 May. The average date for freezeup is 6 November while the earliest date has been 13 October and the latest 23 November.[4]

The Yukon River usually has several spring ice jams along its great length and some of these result in floods.

Local Flying Weather

Local flying weather data for the pipeline crossing area are not available but several distant localities such as Tanana, Bettles, Fort Yukon and Fairbanks have flight data.[18]

Flying conditions for this region are relatively good with 25 to 31 days a month, on the average, having VFR flight conditions.

In the winter the usual hazards exist such as ice fog, blizzards, and whiteout, while June and July often have extensive thunderstorm activity. Forest fire smoke may lower horizontal visibility several miles from the fire source.

5.1.14 Denali Fault Taps Crossing

Local Denali Fault Taps Crossing Weather

This location is within the Alaska Mountain Range near Isabel Pass. The surrounding terrain is mountainous and glaciated and opens to the south into Copper River Basin.

Weather observations are available from Paxson, Summit Lake, Trims Camp and further south at Gulkana.

The climate is continental modified by topographic influences. Means and extremes in temperature and precipitation for Paxson are shown in Table 5-26.

TABLE 5-26

MEANS AND EXTREMES FOR PAXSON

Month	Temperature							Normal heating days (Base 65°)	Precipitation												Relative humidity					
	Normal			Extremes												Snow, Ice pellets										
	Daily maximum	Daily minimum	Monthly	Record highest	Year	Record lowest	Year		Normal total	Maximum monthly	Year	Minimum monthly	Year	Minimum monthly	Year	Mean total	Maximum monthly	Year	Maximum in 24 hrs.	Year	02 Hour	06 Hour	14 Hour	20 Hour (Local time)	Mean speed	Prevailing direction
(a)	(b)	(b)	(b)	12		12		(b)	(b)	10		10		10		11	11		11							
J	2.0	-19.8	-8.9	38	1965	-59	1971		1.09	3.78	1963	0.05	1969	0.80	1963	14.9	42.0	1963	9.0	1963						
F	15.8	-6.8	4.5	42	1970	-44	1971+		0.85	2.41	1962	0.10	1969	1.03	1962	14.0	31.0	1962	15.0	1962						
M	22.1	-4.3	8.9	49	1965	-45	1971		0.98	2.54	1967	0.24	1962	1.10	1967	11.8	17.7	1972	6.5	1971						
A	34.9	10.2	22.6	32	1967	-26	1972		0.87	2.34	1961	0.02	1967	0.78	1961	10.7	17.0	1971+	8.0	1961						
M	48.0	25.6	36.8	69	1969	-9	1964		1.21	2.98	1961	0.16	1967	0.96	1961	2.0	7.0	1972	4.0	1972						
J	61.6	36.3	49.0	85	1969	23	1971		2.51	3.34	1967	1.60	1971	0.95	1966	0.3	2.3	1971	2.3	1971						
J	63.3	41.0	52.2	80	1972+	28	1964		3.22	5.74	1969	1.01	1966	1.92	1964	0.0	0.0	1972+	0.0	1972+						
A	59.5	38.0	48.8	78	1960	13	1966		2.64	4.68	1960	0.92	1964	1.12	1963	0.0	0.0	1972+	0.0	1972+						
S	49.3	29.4	39.4	71	1963	6	1972		2.94	8.72	1960	0.25	1969	1.25	1960	5.3	15.0	1960	13.0	1972						
O	33.1	15.2	24.2	58	1969	-20	1970+		1.80	3.78	1972	0.41	1966	1.15	1961	17.9	37.0	1971	14.0	1971						
N	15.7	-4.5	5.6	42	1970	-39	1969		0.97	2.15	1967	0.21	1963	1.24	1960	14.4	25.9	1970	16.0	1960						
D	6.6	-13.5	-3.5	39	1967+	-55	1964		1.23	2.98	1961	0.27	1969	0.76	1971	18.4	61.5	1971	17.0	1971						
YR	34.3	12.2	23.3	85	JUN. 1969	-59	JAN. 1971		20.31	8.72	SEP. 1960	0.02	APR. 1967	1.92	JUL. 1954	109.7	61.5	DEC. 1971	17.0	DEC. 1971						

Source: Environmental Data Service (NOAA)

Temperatures

Mean monthly temperatures vary from -9°F in January to 52°F in July. Record minimums are in the -50s and record highs in the high 80s. The mean number of days 0°F and below is around 110. A prolonged period of cold weather usually occurs each winter.

Precipitation

The mean number of days of precipitation is around 90 to 100, giving an annual precipitation total of around 20 in. There is a strong orographic influence on the spatial distribution of precipitation due to the rugged terrain. For example, Trims Camp further up the valley receives an annual total of around 40 in. while Gulkana, further southward in the basin, receives around 11 in.

A majority of the annual precipitation occurs during the warmer months due to storms and thunderstorms. Maximum precipitation in 24 hrs is 2 to 5 in., depending on exposure of stations.

The influence of topography is also revealed in the snowfall. Mean annual snowfall total at Gulkana is 47 in., at Paxson 110 in., at Summit Lake 126 in. and at Trims Camp 274 in. The maximum snowfall in 24 hrs varies from 11 to 43 in., depending on the exposure and elevation of the stations.

Winds

Wind data is limited to Gulkana where the prevailing wind is from the southeast during the warm months and from the north during the winter months. Mean monthly speeds vary from 4 knots to 8 knots and maximum wind speeds have varied between 25 and 45 knots. However, at Trims Camp near the top of

Isabell Pass wind speeds are 17 to 35 knots in summer and 26 to 48 knots in winter, with occasional occurrences to 65 knots.[20]

Winter drifting of snow in some areas makes it difficult to keep the roads open.

Cloudiness and Fog

Mean monthly sky cover varies from five-tenths in January to eight-tenths in October with maximum cloudiness in the summer and fall months. On the average, 210 days are cloudy during the year.

The mean number of days with thunderstorms is around five at Gulkana but should be greater at Isabell Pass.

Heavy fog occurs in every month but reaches a maximum in the late summer and fall in the Copper River Basin. Statistics on fog near Isabell Pass are not available.

Freeze-Thaw Cycle

Generally, the thaw season starts in the mean around the first part of June and the freeze season starts around the middle of August.

During the thaw season, spring floods caused by ice jams can create logistic problems.

Local Flying Weather

Local flying weather data for this locality are not available and the nearest station with data is Big Delta,[18] on the north side of the Alaska Range. This station may not be totally representative of the south side of the Alaska Range.

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5.2 TRANSPORTATION AND FIELD SUPPORT REQUIREMENTS

5.2.1 Offshore Yakutat

Figure 5-1 shows the Yakutat area.

Area Characteristics

Distance from Supply Base

Kodiak:

Air - 550 nm

Sea - 550 nm

Anchorage

Air - 425 nm

Local Airports

The only suitable airport in the entire area is at Yakutat. Three airstrips are located further within Yakutat Bay (and, thus, away from the spill area), but they would serve no useful purpose. The features of the Yakutat airport are tabulated below:

	Yes	No
Suitable for HC-130 operations	X	
JP fuel available		X
Instrument landing equipment	X	
Seasonal restrictions		X
Aircraft shelter and maintenance	X	

Local Field and Personnel Support Available

The city of Yakutat is the only large settlement within a 200 mile radius. A Coast Guard Loran Station is located at nearby Ocean Cape. The availability of logistic support functions in Yakutat are tabulated below:

	Yes	No
Quarters		X
Commissary	X	
Vehicle fuel	X	
Road System	X	
Loading Pier	X	
Medical services	X	
Long range communications	X	

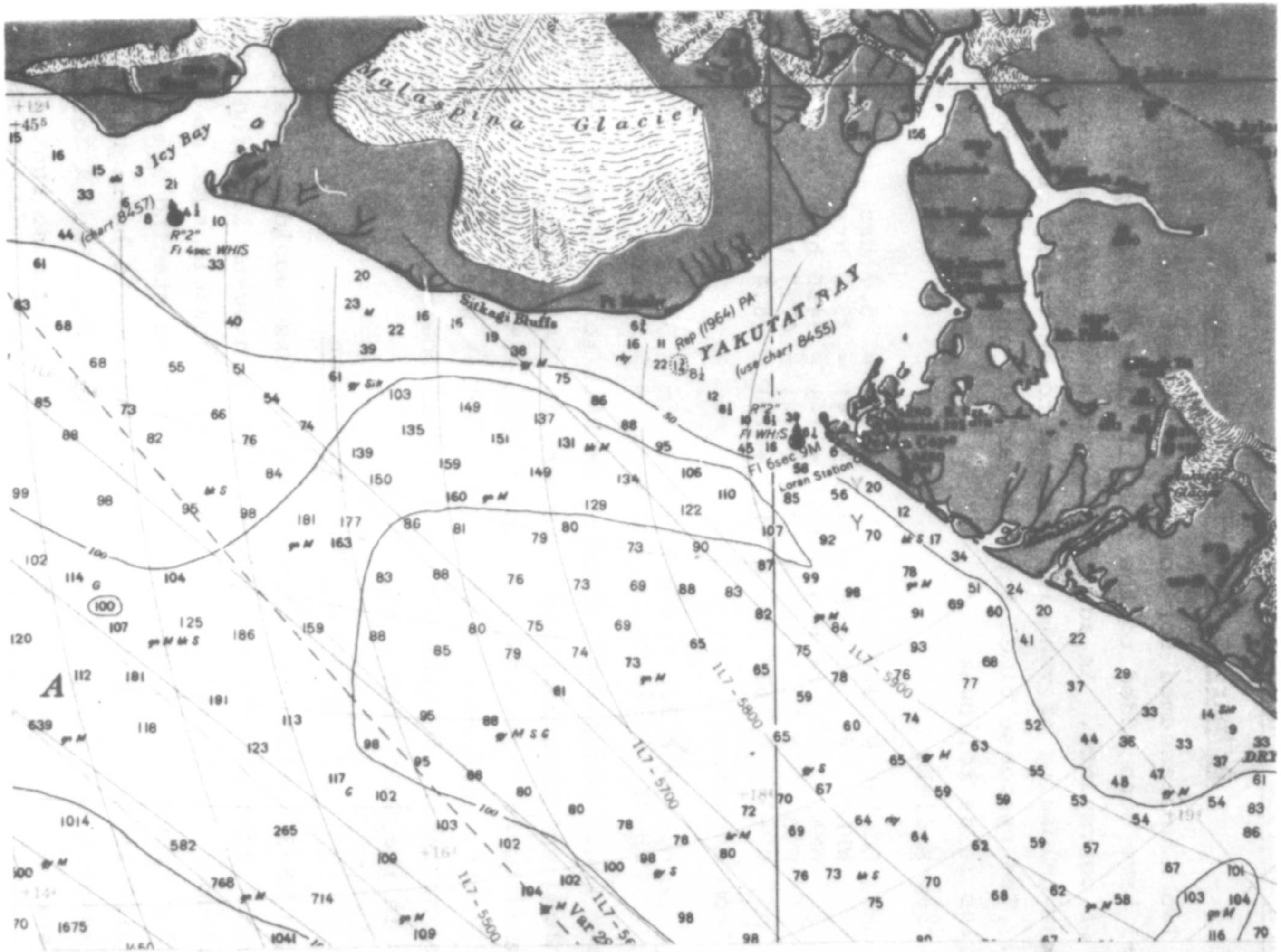

FIGURE 5-1. OFFSHORE YAKUTAT (from C.&G.S. Chart 8002)

Mission Profile (Summer and/or Winter)

Primary Transportation Response

Two hours assumed for loading equipment and securing personnel have been added to the transit time of each potential mode of conveyance. An additional two hours have been added for the unloading of vehicles assumed to be transporting equipment. The response times for the various primary transportation vehicles is as follows:

From Kodiak:

HC-130	@	320 Kts	=	1.7	+	(4)	=	5.7	hrs
WHEC	@	29 Kts	=	19.0	+	(4)	=	23.0	hrs
WMEC	@	18 Kts	=	30.6	+	(4)	=	34.6	hrs
WLB	@	12.8 Kts	=	43.7	+	(4)	=	47.7	hrs
HH-3F	@	128 Kts	=	4.4	+	(2)	=	6.4	hrs

From Anchorage:

HC-130	@	320 Kts	=	1.3	+	(4)	=	5.3	hrs
HH-3F	@	128 Kts	=	3.3	+	(2)	=	5.3	hrs

The two hours added for unloading is felt to be adequate time to unload and transport the equipment to the staging area (assumed to be a city dock or pier) approximately 3 miles from the airport. Response by ships from Kodiak will require a vessel at least the size of a WLB due to oceanographic conditions in the Gulf of Alaska.

Secondary Transportation

An HH-3F helicopter from the supply base would be available for local transportation support. The open ocean location of the assumed spill would necessitate large vessels such as cutters for transport of the equipment from the staging area to the spill site. Approximately three hours would be required to transport the equipment up to 20 miles offshore. A local road system connects the airport with town and also runs a few miles down the beach below Ocean Cape. However, surf conditions

would normally preclude staging the cleanup operations on the ocean beaches. Fishing vessels and commercial vehicles are available in Yakutat.

Discussion

The assumed oil spill location in the Gulf of Alaska would preclude the use of small boats for cleanup efforts. The prevailing coastal feature is low sandy beaches completely exposed to the weather. Normal surf conditions would make transport operations across the surf zone hazardous to conventional vessels. The most suitable staging area is piers or docks in the town of Yakutat, located on Monti Bay. Monti Bay is accessible to any Coast Guard cutter except in the heaviest weather conditions. Large vessels such as cutters would normally be required for working platforms at the spill site.

Conclusions

The desired response time for an open water oil spill such as postulated for Yakutat is 10 hours. Response could be completed within 10 hours under the conditions described below. Equipment and personnel would have to be transported by aircraft from the supply base. Either two HC-130's or one HC-130 and one HH-3F will be required. The HH-3F would have to be refueled in Cordova if carrying personnel. The success of the response operation using only Coast Guard equipment would depend on the availability of a cutter within the immediate area for secondary transportation and use as a working platform. The following distances would apply:

WHEC - within approximately 200 nautical miles.
WMEC - within approximately 130 nautical miles.
WLB - within approximately 100 nautical miles.

The scant number of vessels on Alaska Patrol, expecially during winter months, leads to the conclusion that vessel response to

the Yakutat area within 10 hours is unlikely throughout much of the year. The situation might improve with the advent of tanker traffic from Valdez. Fuel for aircraft operations would have to be brought in from outside.

Requirements to Supplement Capability

Three options are available to provide the vessel needed for secondary transportation and a working platform:

1. Station a cutter in Yakutat
2. Make arrangements to use local boats.
3. Schedule cutters to be within the radii indicated above.

5.2.2 Valdez Narrows

Figure 5-2 shows the Valdez Narrows.

Area Characteristics

Distance from Supply Base

Kodiak:

Air - 350 nm
Sea - 375 nm

Anchorage:

Air - 150 nm
Road - 260 nm

Local Airports

The most suitable airport in the area of the Valdez Narrows is Valdez #2 approximately one mile from Valdez. Cordova Mile 13 airport near Cordova would be the only other possible airport of use. The features of the Valdez #2 airport are tabulated below:

	Yes	No
Suitable for HC-130 operations	X	
JP fuel available		X
Instrument landing equipment		X
Seasonal restrictions		X
Aircraft shelter and maintenance	X	
Landing lights		X

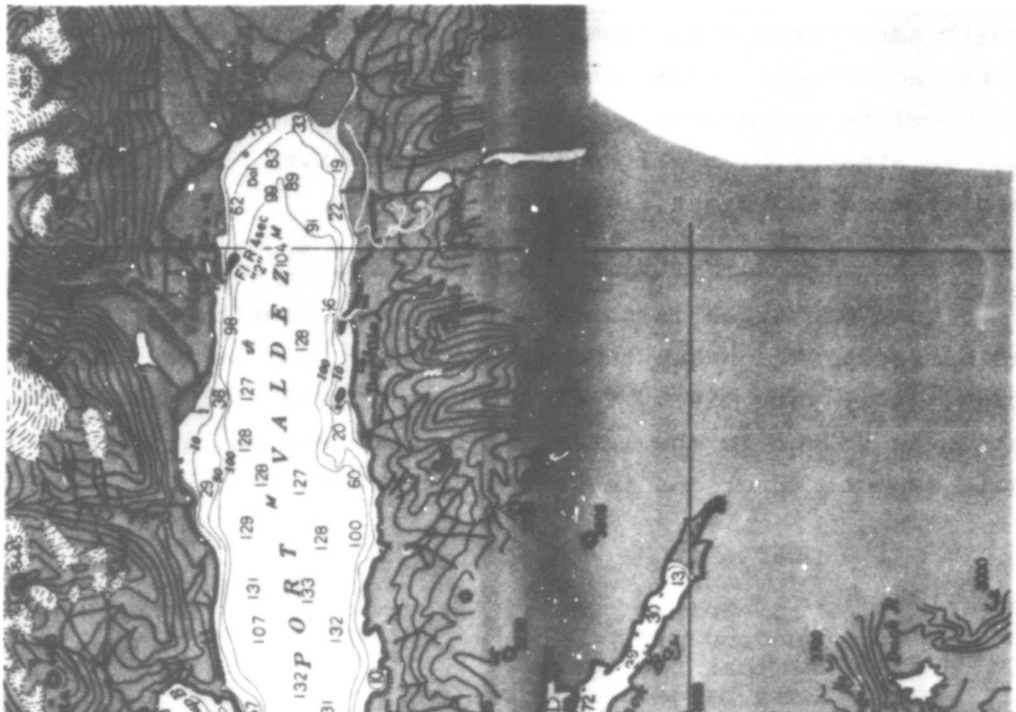

FIGURE 5-2. VALDEZ NARROWS (from C.&G.S. Chart 8551)

The airport at Valdez is expected to improve significantly due to growth associated with construction of the Trans-Alaska Pipeline facilities. Thus, the airport is assumed suitable for round-the-clock operations by the time that Valdez Narrows becomes an area of high oil spill potential (i.e., instrument landing systems and night lighting).

Local Field and Personnel Support Available

The town of Valdez is the only large settlement near the Valdez Narrows. The nearest Coast Guard facility is at Cordova, although, it is very likely that the Coast Guard will establish a Station in Valdez in the late 1970's. The availability of logistic support functions in Valdez are tabulated below:

	Yes	No
Quarters	X	
Commissary	X	
Vehicle fuel	X	
Loading pier	X	
Medical services	X	
Long range communications	X	

Mission Profile (Summer and/or Winter)

Primary Transportation Response

Two hours assumed for loading equipment and securing personnel have been added to the transit time of each potential mode of conveyance. An additional two hours have been added for the unloading of vehicles assumed to be transporting equipment. The response time for the various primary transportation vehicles is as follows:

From Kodiak:

HC-130 @ 320 Kts = 1.1 + (4) = 5.1 hrs
WHEC @ 29 Kts = 12.9 + (4) = 16.9 hrs
WMEC @ 18 Kts = 20.8 + (4) = 24.8 hrs
WLB @ 12.8 Kts = 29.3 + (4) = 33.3 hrs
HH-3F @ 128 Kts = 2.7 + (2) = 4.7 hrs

From Anchorage:

HC-130 @ 320 Kts = 0.5 + 4 = 4.5 hrs
HH-3F @ 128 Kts = 1.2 + 2 = 3.2 hrs
Commercial vehicle @ 40 mph = 7.5 + (4) = 11.5 hrs

The two hours added for unloading is felt to be adequate time to unload and transport the equipment to a staging area (assumed to be a dock or pier in Valdez) approximately one mile from the airport. Response by ships from Kodiak would require a vessel at least the size of a WI' due to oceanographic conditions in the Gulf of Alaska.

Secondary Transportation

The inaccessibility of the beaches along the Valdez Narrows would limit secondary transportation to vessels or helicopters. An HH-3F helicopter from the supply base could be available for secondary transportation functions such as personnel transport. The Valdez Narrows are located approximately 10 nautical miles from the town which would require approximately two hours additional for transport from the staging area to the spill site (includes one hour for loading). Several types of vessels would be available at Valdez for secondary transportation either from the fishing industry or the oil industry. A WLB stationed at Cordova would be within five to seven hours of Valdez if in port at the time of the spill. Secondary transportation would also be available from any Coast Guard cutter on patrol within 100 to 200 nautical miles of Valdez.

Discussion

Oceanographic conditions around the Valdez Narrows would permit use of vessels smaller than cutters for field support and as working platforms. The most suitable staging area will be docks or piers in Valdez. An oil spill cooperative will

be formed by 1977 that will have the personnel, some equipment, and the transportation support vessels available to the Coast Guard.

Conclusions

The desired response time for the open water spill postulated in the Valdez Narrows is 10 hours. Response could be complete within 10 hours under the conditions described below. Equipment and personnel would be transported from the supply base by aircraft. Either two HC-130's or one HC-130 and one HH-3F would be required. Successful response using only Coast Guard equipment would depend on the availability of a cutter within the immediate area (<100 to 200 nautical miles) for secondary transportation and use as a working platform. The WLB stationed in Cordova would normally be available. Local vessels could be used for secondary transportation and field operations by prior arrangements. Fuel for aircraft operations would have to be brought in from outside.

Requirements to Supplement Capability

The need for vessels could be met by either stationing a vessel in Valdez or making arrangements to use suitable local vessels. The Coast Guard will likely have a boat permanently stationed in Valdez by the time the North Slope oil is moved from Valdez. The boat should be large enough to provide a working platform in all waters of the Valdez Arm.

5.2.3 Offshore Port Graham

Figure 5-3 shows the Port Graham area.

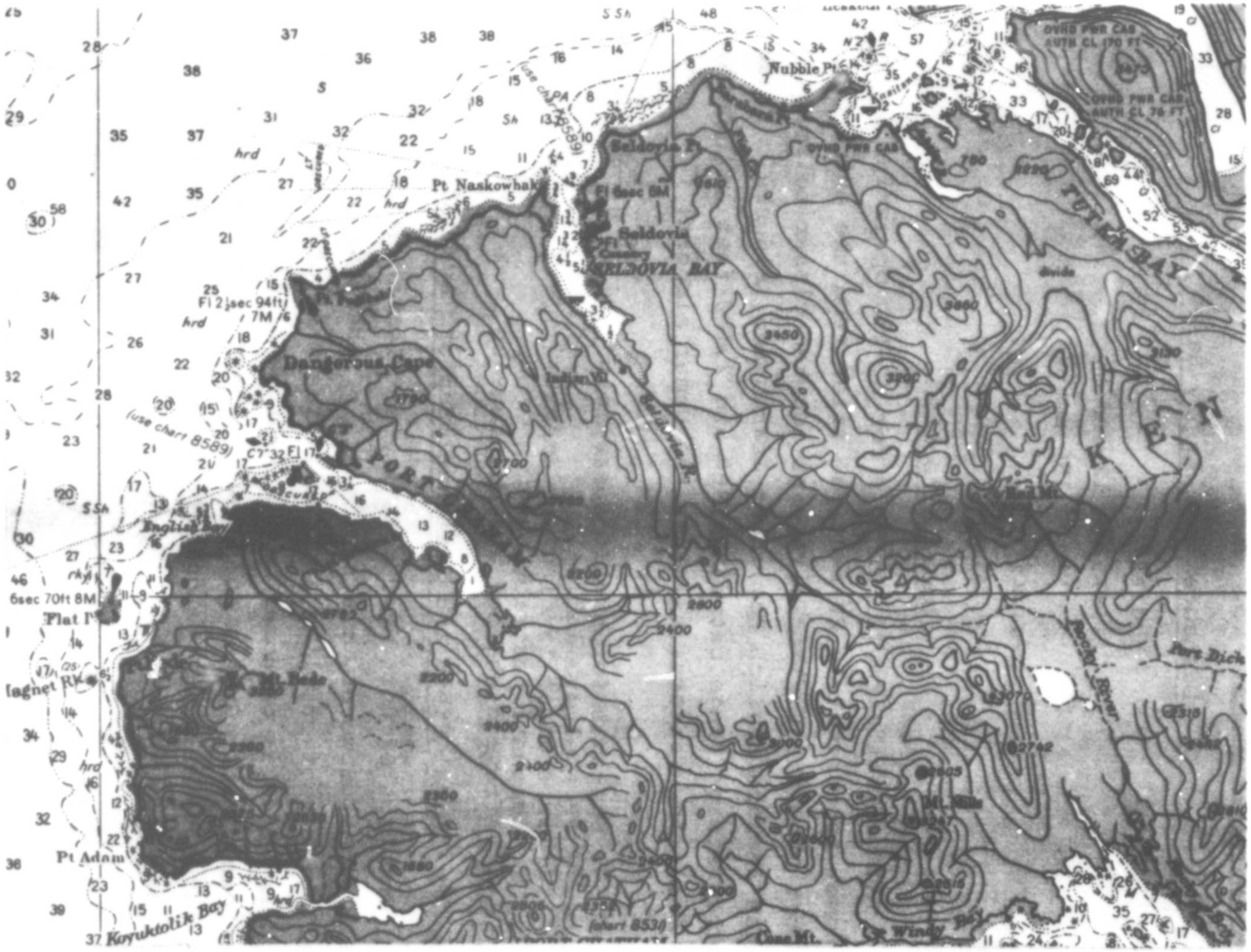

FIGURE 5-3. OFFSHORE PORT GRAHAM (from C.&G.S. Chart 8554)

Area Characteristics

Distance from Supply Base

Kodiak:

Air - 125 nm

Sea - 150 nm

Anchorage:

Air - 175 nm

Local Airports

The nearest airport suitable for HC-130 operation is at Homer approximately 20 nautical miles from the entrance to Port Graham. Smaller airstrips located closer to Port Graham include English Bay, Port Graham and Seldovia. These smaller strips range between 1,800 and 2,100 feet in length. The following features exist at the Homer airport:

	Yes	No
Suitable for HC-130 operations	X	
JP fuel available		X
Instrument landing equipment	X	
Seasonal restrictions		X
Aircraft shelter and maintenance	X	

Local Field and Personnel Support Available

The town of Port Graham is the settlement nearest to the spill site. However, the small size of the town and limited availability of supplies and facilities make other settlements such as Seldovia or Homer better sources of field support. The town of Port Graham does have a wharf suitable for docking large vessels.(1) Logistic support functions in Homer include:

	Yes	No
Quarters	X	
Commissary	X	
Vehicle fuel	X	
Road system	X	
Loading pier	X	
Medical services	X	
Long range communications	X	

Mission Profile (Summer and/or Winter)

Primary Transportation Response

Two hours assumed for loading equipment and securing personnel have been added to the transit time of each potential mode of conveyance. An additional two hours have been added for the unloading of vehicles assumed to be transporting equipment. The response time for the various primary transportation vehicles is as follows:

From Kodiak:

HC-130 @ 320 Kts = 0.4 + (4) = 4.4 hrs
WHEC @ 29 Kts = 5.2 + (4) = 9.2 hrs
WMEC @ 18 Kts = 8.3 + (4) = 12.3 hrs
WLB @ 12.8 Kts = 11.7 + (4) = 15.7 hrs
HH-3F @ 128 Kts = 1.0 + (2) = 3.0 hrs

From Anchorage:

HC-130 @ 320 Kts = 0.5 + (4) = 5.4 hrs
HH-3F @ 128 Kts = 1.4 + (2) = 3.4 hrs
Commercial vehicle to Homer @ 40 mph = 5.7 + (4) = 9.7 hrs

Response from vessels from Kodiak would require a vessel at least the size of a WLB due to oceanographic conditions in the Gulf of Alaska and the entrance to Cook Inlet.

Secondary Transportation

Transportation from a staging area at Homer or Port Graham to the offshore site would normally require vessels the size of a cutter. An HH-3F helicopter from the supply base could be available for local transportation support. There are no roads in the area. Fishing vessels are available in Homer and Seldovia. Transport of equipment from a staging area at Homer would add approximately three hours to the response time.

Discussion

The assumed oil spill location is near the entrance to Cook Inlet which necessitates large vessels (cutters) for secondary transportation and as working platforms due to adverse oceanographic conditions. Sea ice should not present a problem during the winter in this area. The relatively short distance between Port Graham and Kodiak permits use of either High Endurance Cutters or aircraft for primary transportation response. A cutter or other suitable vessel would have to be available at Homer within approximately seven hours of the call for assistance if aircraft or land vehicles were used for primary transportation.

Homer has the best facilities for staging operations and is felt close enough to the site to adequately serve the purpose. The WLB stationed at Homer would serve as a working platform and secondary transportation vehicle if available at the time of the spill.

Conclusions

The desired response time of 10 hours for open water spills can be met by using aircraft for primary transportation response or if a High Endurance Cutter is available in Kodiak. Arrangements may be required for secondary transportation from Homer to the site if Coast Guard cutters are not immediately available due to other missions.

Requirements to Supplement Capability

Making arrangements to use local vessels when cutters are not available would improve response capability.

5.2.4 Drift River Terminal

Figure 5-4 shows the Drift River area on the west side of Cook Inlet.

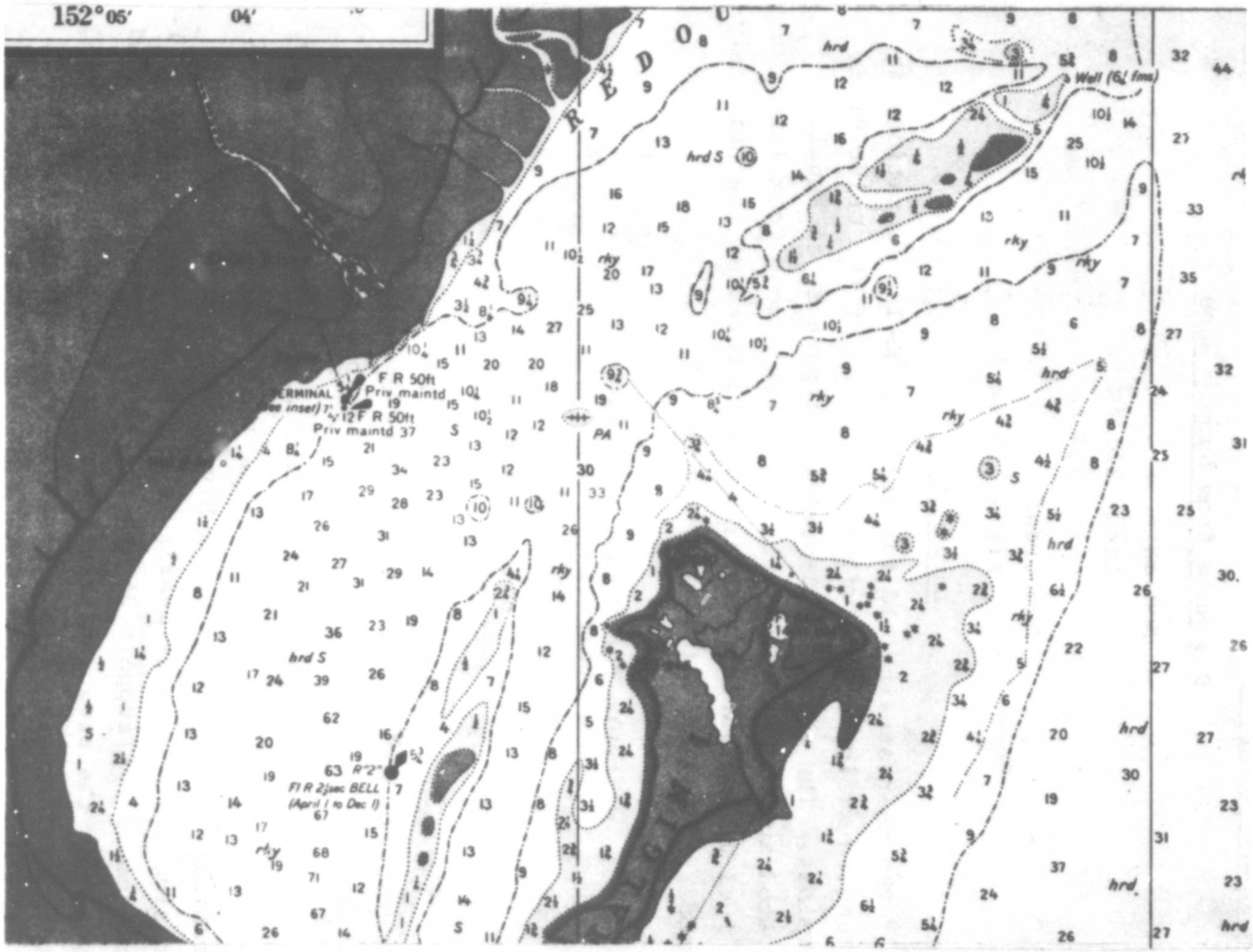

FIGURE 5-4. DRIFT RIVER TERMINAL (from C.&G.S. Chart 8553)

Area Characteristics

Distance from Supply Base

Kodiak:

Air - 225 nm

Sea - 250 nm

Anchorage:

Air - 100 nm

Local Airports

The nearest airfield suitable for HC-130 operations is a landing strip located within two miles of the Drift River Terminal. The nearest all-weather airport is at Kenai, located approximately 30 nautical miles across Cook Inlet. JP fuel is available at Kenai. The features of the privately-owned airfield at Drift River include:

	Yes	No
Suitable for HC-130 operation	X	
JP fuel available		X
Seasonal restrictions	X	
Aircraft shelter and maintenance		X
Instrument landing equipment		X
Runway lighting	X	

The seasonal restrictions would apply during periods of snowfall in the winter. During snowfall or periods of low visibility, Kenai is the nearest suitable airport.

Local Field and Personnel Support Available

The only source of immediate local support is the terminal facilities at Drift River. Temporary shelter and housing could be made available. However, the support available could not support 25 men for 10 days. There is no road system in the area and the tanker terminal is the only suitable local staging area. Kenai is the nearest city with

adequate supplies and support services. The Cook Inlet Oil Spill Cooperative in Anchorage would have a variety of logistic support functions available.

Mission Profile (Summer)

Two hours assumed for loading equipment and securing personnel have been added to the transit time of each potential mode of conveyance. An additional two hours have been added for the unloading of vehicles assumed to be transporting equipment. The response time for various primary transportation vehicles is as follows:

From Kodiak:

HC-130	@	320 Kts	=	0.7 + (4)	=	4.7 hrs	
WHEC	@	29 Kts	=	8.6 + (4)	=	12.6 hrs	
WMEC	@	18 Kts	=	13.9 + (4)	=	17.9 hrs	
WLB	@	12.8 Kts	=	19.5 + (4)	=	23.5 hrs	
HH-3F	@	128 Kts	=	1.8 + (2)	=	3.8 hrs	

From Anchorage:

HC-130 @ 320 Kts = 0.3 + (4) = 4.3 hrs
HH-3F @ 128 Kts = 0.8 + (2) = 2.8 hrs
Commercial vehicle to Kenai
@ 40 mph = 4 + (4) = 8.0 hrs

From Homer:

WLB @ 12.8 Kts = 5.4 + (2) = 7.4 hrs

Secondary Transportation

Secondary transportation requirements will depend upon the staging area chosen. If the Drift River airstrip is used, local vehicles at the terminal facility could move men and equipment from the landing strip to the terminal pier. The pier is not connected to shore. No local roads exist and mudflats extending over 1,000 yards from the shoreline would virtually preclude the transition from shoreside to the water by conventional vehicles. The working platform for

cleanup activities would have to be a large vessel such as a cutter due to oceanographic conditions in this area of Cook Inlet.

A second choice of staging area is the tanker terminal at Nikiski across Cook Inlet. Water depths at Kenai preclude loading of larger vessels which precludes use as a staging area. Equipment and personnel air transported to Kenai would be moved the additional 15 miles to Nikiski by commercial vehicle and transferred to a vessel. The total time estimated for transport of equipment from the Kenai airport to the Drift River area is six hours including loading and unloading of secondary transport vehicles.

Mission Profile (Winter)

Ice conditions in the Drift River area of Cook Inlet during severe winters would require ice-reinforced vessels or ice-breakers for secondary transportation and as working platforms. Response in other respects would be similar to summer operations. Quartering of personnel on Coast Guard cutters operating in the spill area would be almost mandatory due to the potential difficulty in moving men to and from the working platform during winter.

Discussion

The marine spill assumed at Drift River will require large vessels such as cutters during the summer and ice-breakers or ice-reinforced vessels during severe winters for secondary transportation and personnel transfer. Helicopters would be of limited use unless they could land on the ships. The coastline of Cook Inlet in this area is typically long mud flats, which makes the shoreline virtually inaccessible except by helicopter or All Terrain Vehicle. JP fuel is available at Kenai.

Conclusions

The desired response time of under 10 hours for open water spills could be met using Coast Guard equipment only if a cutter was available within Cook Inlet. The WLB stationed at Homer could respond in time if available. Oil spills on ice during the winter would presumably fall within the category of spills on shorefast or sea ice. The desired response time in this case would be 24 hours. Response within the 24-hour period would depend entirely upon the availability of an ice-breaker or ice-reinforced cutter at either Kodiak or within Cook Inlet.

Requirements to Supplement Capability

The primary improvement would be the establishment of working agreements with the Cook Inlet Oil Spill Cooperative and/or the individual oil companies to obtain use of vessels, services and equipment. Air-drop capability for the equipment would also help.

5.2.5 Unimak Pass

Figure 5-5 shows the area surrounding Unimak Pass.

Area Characteristics

Distance from Supply Base

Kodiak:
- Air - 650 nm
- Sea - 700 nm

Anchorage:
- Air - 850 nm

Local Airports

The airport nearest Unimak Pass suitable for HC-130 transportation operations is at Dutch Harbor. Cold Bay is another suitable airfield farther away. The Coast Guard

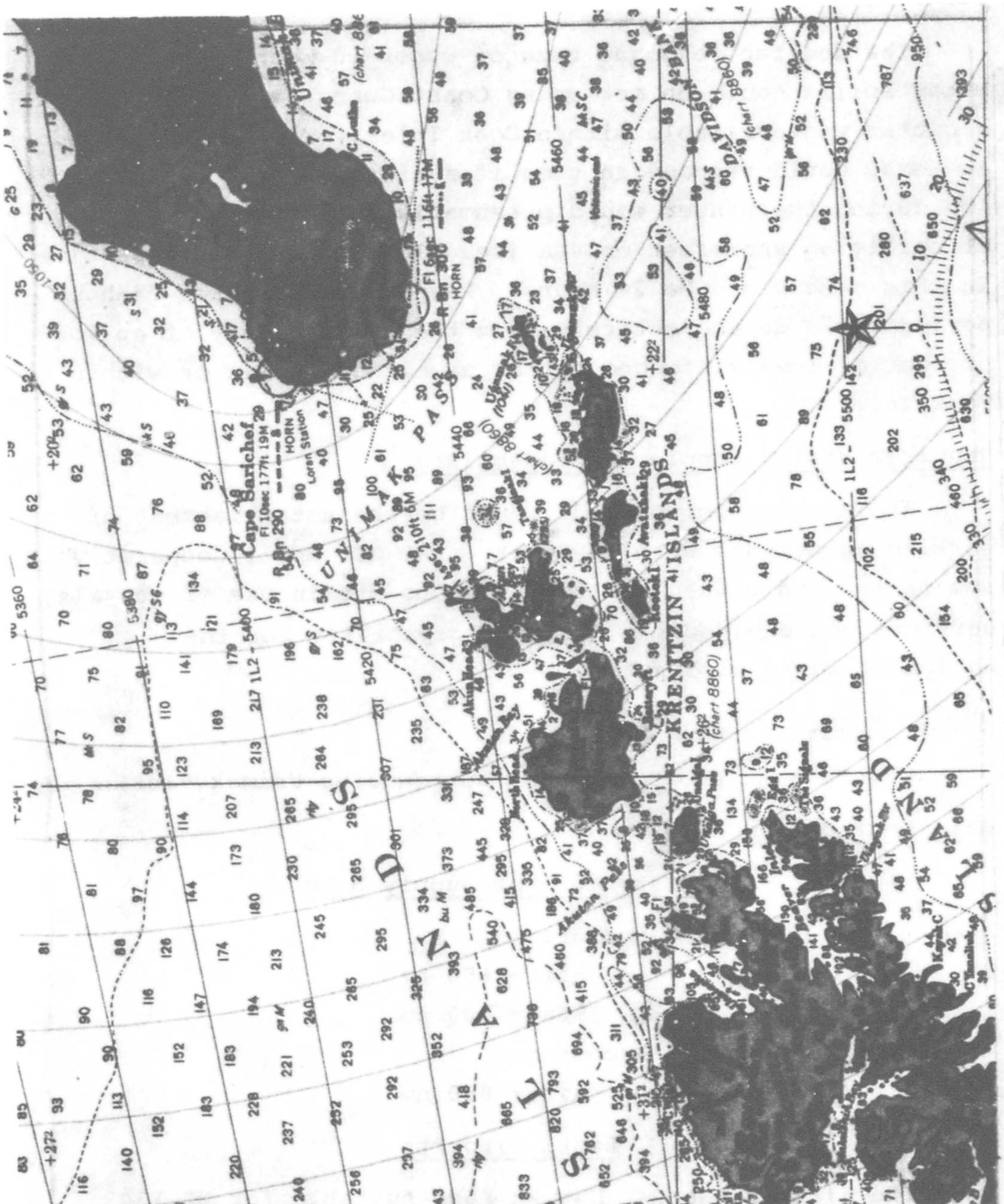

FIGURE 5-5. UNIMAK PASS (from C.&G.S. Chart 8802)

facility at Cape Sarichef nearby has a 3,500 foot landing strip. However, lack of nearby docking facilities and doubts that a fully-loaded HC-130 could land on the strip preclude choice as a staging area. Features of the Dutch Harbor airport are as follows:

	Yes	No
Suitable for HC-130 operations	X	
JP fuel available		X
Instrument landing equipment		X
Seasonal restrictions	X	
Aircraft shelter and maintenance	X	
Runway lighting		X

The seasonal restrictions would be during periods of snowfall because of inadequate snow removal equipment.

Local Field and Support Functions

Several fish processing plants are located in the towns of Dutch Harbor and nearby Unalaska. Limited supplies and housing would be available on a temporary basis. A Coast Guard Station is located at Cape Sarichef on Unimak Pass and would also be a limited source of supplies. Support functions in Dutch Harbor or Unalaska include:

	Yes	No
Quarters		X
Commissary	X	
Vehicle fuel	X	
Road system		X
Loading pier	X	
Medical services	X	
Long range communications	X	

Mission Profile (Summer and/or Winter)

Primary Transportation Response

Two hours assumed for loading equipment and securing personnel have been added to the transit time of each potential mode of conveyance. An additional two hours have been added

for the unloading of vehicles assumed to be transporting equipment. Helicopters conveying personnel would have to refuel at Cold Bay enroute (one hour). HH-3F's could not respond from Anchorage without refueling in flight. The response times for the various primary transportation vehicles is as follows:

From Kodiak:

HC-130 @ 320 Kts = 2.0 + (4) = 6.0 hrs
WHEC @ 29 Kts = 24.1 + (4) = 28.1 hrs
WMEC @ 18 Kts = 38.9 + (4) = 42.9 hrs
WLB @ 12.[illegible] Kts = 54.7 + (4) = 58.7 hrs
HH-3F @ 128 Kts = 5.1 + (2) + (1) = 8.1 hrs

From Anchorage:

HC-130 @ 320 Kts = 2.7 + (4) = 6.7 hrs

The two hours added for unloading is felt adequate to unload and transport equipment from the airport to the staging area at a local pier (approximately one mile).

Secondary Transportation

The Unimak Pass area is up to 90 nautical miles from Dutch Harbor which would require an additional 4 to 8 hours of transport time from the assumed staging area at Dutch Harbor, depending upon the type of cutter available. A vessel suitable as a working platform in the waters surrounding Unimak Pass would have to be at least the size of a WLB. An HH-3F helicopter or fishing vessels from Dutch Harbor could be used for personnel transport and other field support functions. There is no road system anywhere in the area and shorelines are virtually inaccessible except by helicopter.

Discussion

The lack of instrument landing equipment and runway lights at Dutch Harbor would limit air transportation to daylight hours with appropriate visibility unless portable

approach control systems were established in advance of the HC-130. The oceanographic conditions in Unimak Pass normally preclude use of vessels smaller than cutters for transport and working platforms. Personnel would have to be quartered on Coast Guard vessels at the spill site to prevent several hours per day of ferrying back and forth from the staging area.

Conclusions

The desired response time of 10 hours for an open water spill in Unimak Pass cannot be met with present Coast Guard equipment. The response period would depend upon the availability of nearby Coast Guard cutters. Response could require well over 24 hours if a High Endurance Cutter was no closer than Kodiak.

Requirements to Supplement Capability

Stationing a cutter at Dutch Harbor would normally fulfill response requirements, providing the vessel was nearby. The capability to air-drop all equipment could also cut several hours off the response time by saving transit time of vessels to and from the staging area at Dutch Harbor.

5.2.6 Offshore Port Moller

Figure 5-6 shows the area of Bristol Bay around Port Moller.

Area Characteristics

Distance from Supply Base

Kodiak:

Air - 375 nm

Sea - 950 nm

Anchorage:

Air - 625 nm

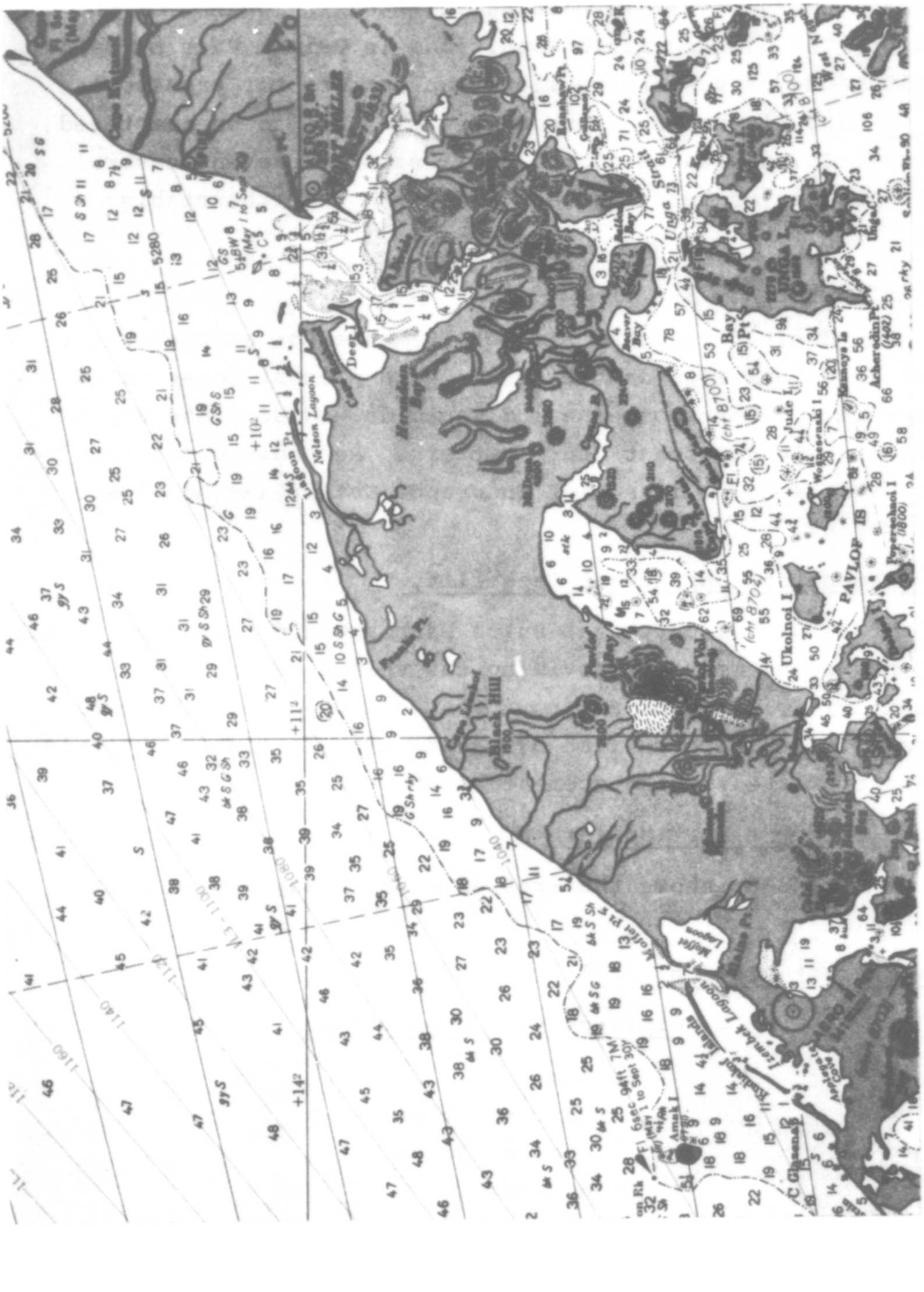

FIGURE 5-6. OFFSHORE PORT MOLLER (from C.&G.S. Chart 8802)

Local Airports

The airports most suited to HC-130 operations in the Port Moller area are located at Cold Bay and Port Heiden. Both airports are approximately 90 nautical miles away in opposite directions. Cold Bay is on the southern side of the Alaskan Peninsula and would, therefore, be of less value as a staging area. Closer airfields include Sandy River Federal (approximately 22 miles northeast of Port Moller), Port Moller Air Force Station (approximately one mile from Port Moller), and Hendereen Bay (approximately 20 miles from Port Moller). The most suitable of the three nearby airfields is at Port Moller with a 3,500 foot gravel runway. The runway is not considered of adequate length to land a fully-loaded HC-130.

Local Field and Personnel Support Available

The availability of supplies and equipment is extremely limited in the Port Moller area. The nearby Air Force Station is perhaps the best potential source. It is unlikely that 25 personnel could be quartered for 10 days anywhere in the local area. Thus, food and shelter would have to be transported to the area.

Mission Profile (Summer and/or Winter)

The summer and winter response are considered approximately the same because sea ice is not encountered in the Port Moller area during a normal year. Drift ice is troublesome but does not normally restrict navigation.

Primary Transportation Response

Use of vessels for primary transportation from Kodiak is out of the question because the response time of High Endurance Cutters exceeds 1½ days. HC-130 aircraft from Kodiak could

transport equipment to the suitable airports 90 nautical miles away from Port Moller within 5 to 6 hours. Personnel could be transported within the same time frame by HH-3F helicopter from Kodiak to Port Moller. A very significant problem would arise in transfer of the equipment from the aircraft to the working platform. Docking facilities with adequate depth alongside for Coast Guard cutters do not exist along the coastline in the vicinity of Port Moller. Therefore, even if a cutter were available (which is doubtful during the winter), the equipment would have to be transferred by helicopter as the vessel stood offshore. Such a transfer would be very time consuming.

Secondary Transportation

An HH-3F helicopter(s) could be available from the supply base in Kodiak or Anchorage. Local small fishing vessels are common in the area throughout the summer season. Larger crab fishing vessels might be within the general area during portions of the winter. Coast Guard cutters would probably be within the general area only during the summer.

Discusssion

The oceanographic conditions at the assumed oil spill site in the Bering Sea would require vessels the size of cutters most of the year for working platforms. The choice of a staging area will depend somewhat upon the availability of cutters. JP fuel is available at Cold Bay and Cold Bay could prove to be the best staging area because of the fuel needed for airlift operations by helicopter.

Conclusion

The desired response time of 10 hours for the postulated open water spill offshore of Port Moller is not likely to be met. In fact, response within 24 hours using only Coast

Guard equipment may prove difficult during the winter unless a cutter is in the immediate area of Port Moller at the time of the spill. Primary transportation is feasible only by aircraft due to distance and the lack of a suitable staging area would greatly complicate transfer of equipment to the site.

Requirements to Supplement Capability

Stationing a Surface Effect Vehicle in the Bristol Bay area is felt to be by far the best approach to improving response capability throughout the area from Unimak Pass to the head of Bristol Bay. The SEV's, in effect, overcome the problem of limited staging areas by traveling to virtually any airport. The advantages of SEV's are further manifest by the capability to operate in the very shallow waters found off all coastlines of the area. Employment of an SEV can probably be justified more for the Bristol Bay area than any other in Alaska due to the combination of intense fishing activity in the summer, the problem of winter sea ice, the high potential for oil spills throughout the area, and the restrictions on operation of conventional vessels due to the shallow water.

Developments of complete air-drop capability from HC-130's for the equipment would also reduce the response time considerably if a cutter was in the area. Arrangements to use local boats for secondary transportation and as working platforms during the winter might be effective when sea ice is not present.

5.2.7 Kvichak Bay

Figure 5-7 shows Kvichak Bay as a long arm at the head of Bristol Bay.

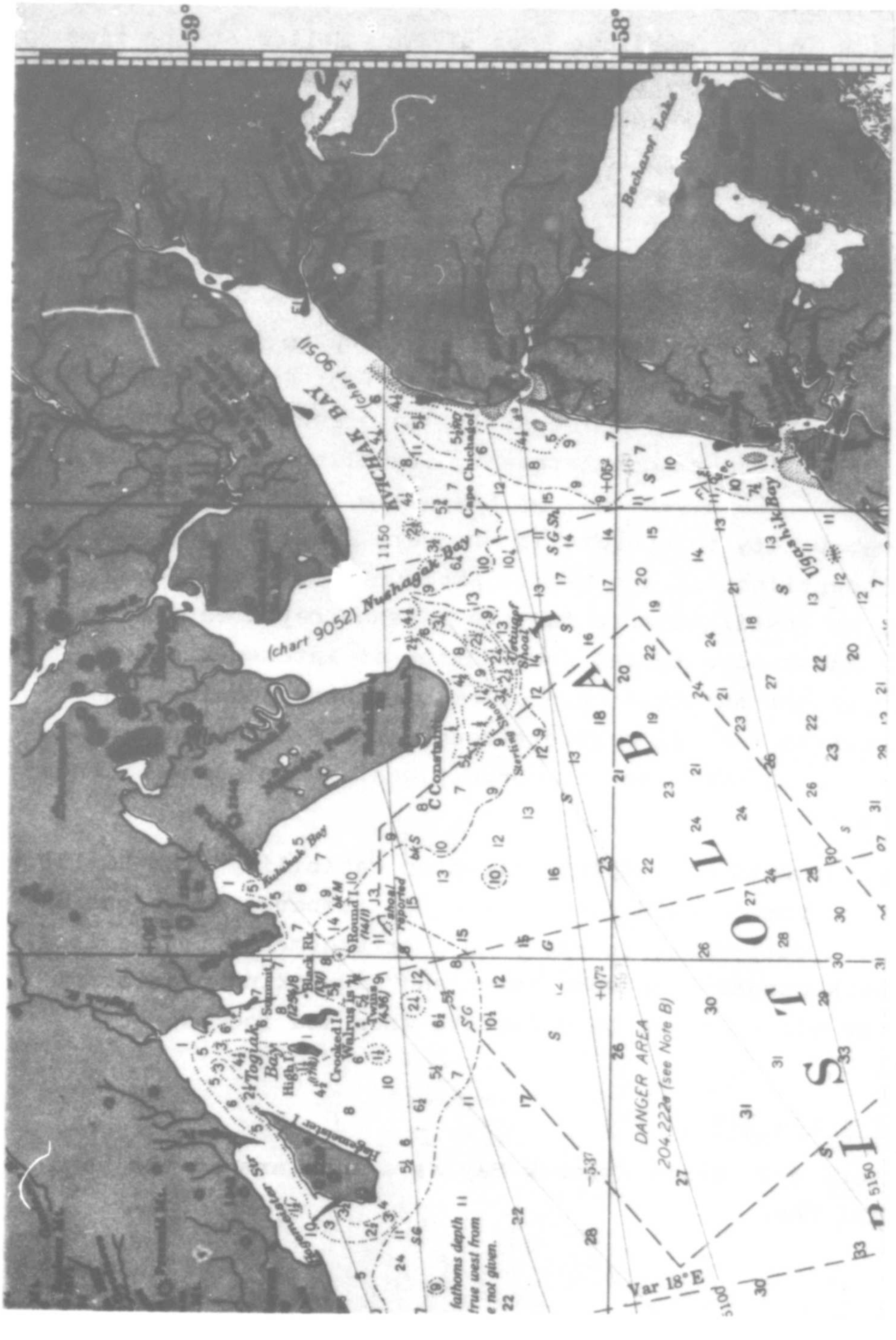

FIGURE 5-7. KVICHAK BAY (from C.&G.S. Chart 9302)

Area Characteristics

Distance from Supply Base

Kodiak:

Air - 200 nm

Sea - 1,200 nm

Anchorage:

Air - 350 nm

Local Airports

At least nine airports and landing strips are located around Kvichak Bay. The only two airports suitable for HC-130 operations are at King Salmon and Dillingham. Shorter landing strips are located at Egegik, Kvichak, Levelock, Naknek, Pederson Point, South Naknek and Tibbetts. King Salmon is the preferred terminal for primary transportation because of ready access to cannery wharves at Naknek. The wharves accessible by road from King Salmon will accommodate deeper draft vessels than those accessible from Dillingham. Features of the King Salmon airport are tabulated below:

	Yes	No
Suitable for HC-130 operations	X	
JP fuel available	X	
Instrument landing system	X	
Seasonal restrictions		X
Aircraft shelter and maintenance		X

Local Field and Personnel Support Available

Several large and small settlements are located along Kvichak Bay. Dillingham is the largest with a population of approximately 1,000. During the summer fishing season, ample supplies would be available from the numerous fishing canneries. Other logistic support functions available year-round in the Kvichak Bay area include:

	Yes	No
Quarters	X	
Commissary	X	
Vehicle fuel	X	
Road system	X	
Loading pier	X	
Medical services	X	
Long range communications	X	

Mission Profile (Summer)

Primary Transportation Response

HC-130 aircraft are the only feasible means of primary transportation for equipment to the Kvichak Bay area. HH-3F helicopters could be used for transport of personnel from Kodiak. Response time for the HC-130 would be 4 to 5 hours including time for loading at the supply base and transferring the equipment to the staging area at Naknek. Response time for the HH-3F transporting personnel would be approximately three hours.

Secondary Transportation

Local personnel transport and offshore working platforms could be provided by local fishing vessels if Coast Guard cutters were unavailable. Virtually all wharves in the Kvichak Bay area bare alongside at low water. Tides exceed 20 feet at the upper end of Kvichak Bay; therefore larger vessels must await high tide to use the wharves. The 20-foot draft of High Endurance Cutters would severely limit the effectiveness for secondary transportation.

Few established road systems exist in the area and most local transportation has historically been by air or sea. Amphibious off-road vehicles or helicopters from the supply base would be required for operations along the shorelines. Off-road vehicles are generally unavailable in the area.

Mission Profile (Winter)

Primary Transportation Response

Primary transportation considerations are essentially the same as those for the summer mission profile discussed above. The same staging area at Naknek appears to be the most suitable.

Secondary Transportation

Kvichak Bay is frozen over during the winter. Local boats are not capable of sustained operation in the ice and most are pulled ashore for the winter. The availability of Coast Guard ice-breakers or ice-reinforced cutters in the area within 24 hours is doubtful during the winter season. Overland travel in the winter is easier than similar travel in the summer due to the frozen ground. Helicopters from the supply base could be available for local transportation.

Discussion

Vessels with shallow draft are most suited to operating within Kvichak Bay. The lack of roads and extensive mud flats along both sides and at the head of Kvichak Bay virtually preclude access to the water from the shores by conventional vehicles. Over 1,000 fishing vessels are in the area during the summer, but virtually none are available during the winter.

Conclusions

The capability to respond to an open water spill within 10 hours using Coast Guard equipment during the summer is doubtful. Lack of Coast Guard cutters suitable for working platforms and the dependence on high tides for transfer of equipment severely hamper rapid response efforts. The use of local

boats for working platforms and local transportation would improve response capability.

The capability to respond to spills on the ice during the winter within 24 hours is similarly doubtful due to the probable lack of vessels for secondary transportation and use as working platforms. Shelters for personnel might have to be provided during the winter season if prior arrangements had not been made with local industry.

Requirements to Supplement Capability

Stationing a Surface Effect Vehicle in this area would very significantly improve response capability for the same reasons discussed in Section 5.1.6. Air-drop capability for the equipment would reduce response time.

5.2.8 Offshore Nome

Figure 5-8 shows the area offshore from Nome.

Area Characteristics

Distance from Supply Base

Kodiak:

Air - 725 nm

Sea - 1,500 nm

Anchorage:

Air - 650 nm

Local Airports

The only suitable airfield in the Nome area is Nome Municipal Airport located approximately two miles from the city. The 4,500 foot Port Clarence Coast Guard Station airfield located approximately 60 nautical miles northwest is also suitable for HC-130 operations. Features of the Nome airport are tabulated below:

	Yes	No
Suitable for HC-130 operations	X	
JP fuel available	X	
Instrument landing equipment	X	
Seasonal restrictions		X
Aircraft shelter and maintenance	X	

Local Field and Personnel Support Available

The city of Nome (population $\sim$2,500) is the only large settlement within a radius of approximately 200 miles. The availability of logistic support functions in Nome is tabulated below:

	Yes	No
Quarters	X	
Commissary	X	
Vehicle fuel	X	
Road system	X	
Loading pier		X
Medical services	X	
Long range communications	X	

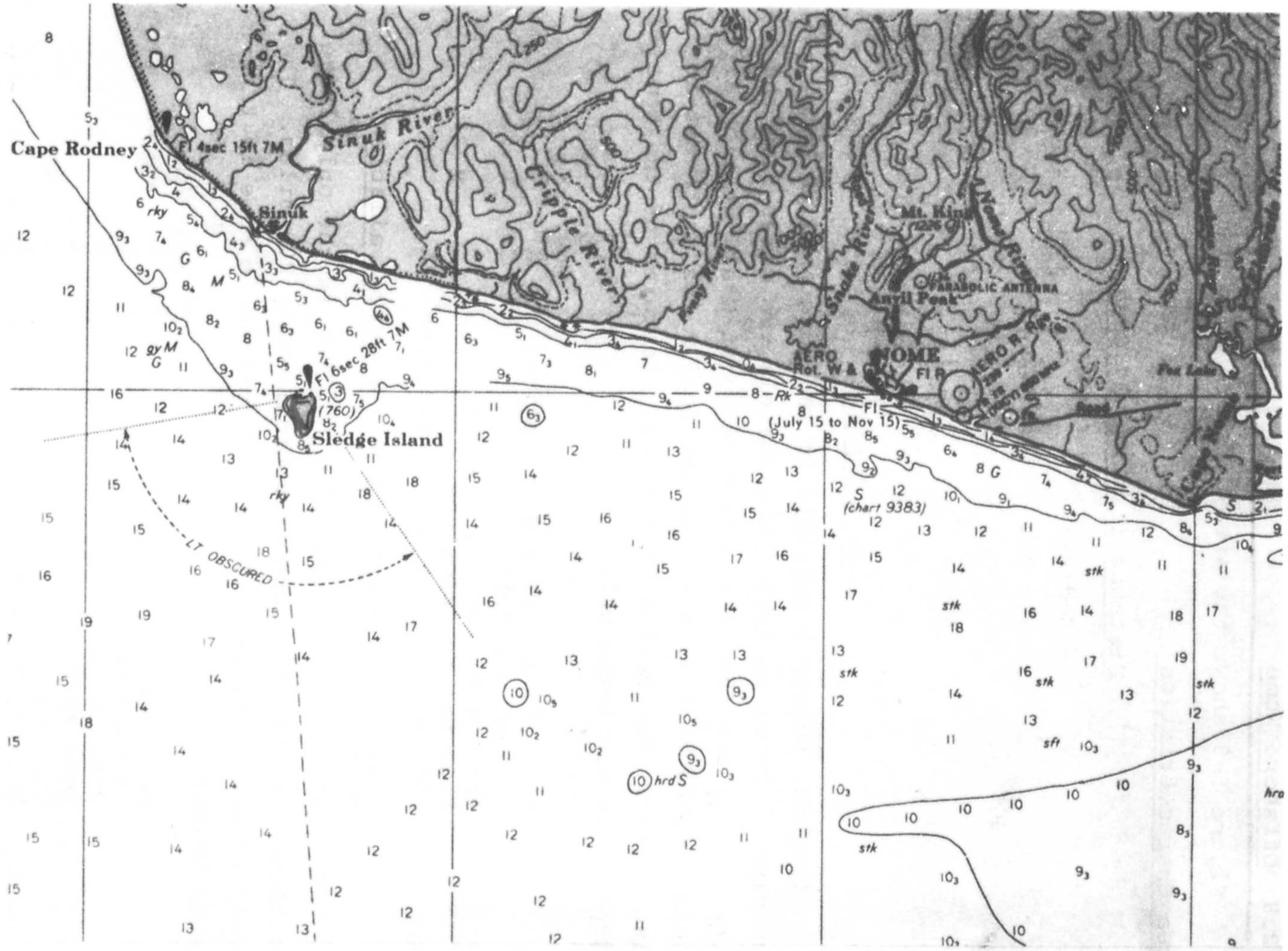

FIGURE 5-8. OFFSHORE NOME (from C.&G.S. Chart 9380)

Mission Profile (Summer)

Primary Transportation Response

Two hours assumed for loading equipment and securing personnel have been added to the transit time of each potential mode of conveyance. An additional two hours have been added for the unloading of vehicles assumed to be transporting equipment. Helicopter transit times assume one refueling stop (one additional hour). A refueling stop near McGrath is assumed, although JP fuel is not presently available at McGrath. The response times for the various primary transportation vehicles is as follows:

From Kodiak:

HC-130 @ 320 Kts = 2.3 + (4) = 6.3 hrs
HH-3F @ 128 Kts = 6.0 + (2) + (1) = 9.0 hrs
Cutters will require more than two days

From Anchorage:

HC-130 @ 320 Kts = 2.0 + (4) = 6.0 hrs
HH-3F @ 128 Kts = 5.1 + (2) + (1) = 8.1 hrs

Secondary Transportation

Coast Guard cutters will normally not be available in the Nome area. HH-3F helicopters from the supply base would be required for local transportation of personnel. Deep draft vessels can approach within approximately one mile of the beach at Nome.[1] All cargo is normally lightered from that point to the shallow harbor. Transfer facilities that are open to the public are available in the harbor. These transfer facilities are felt to be the best staging area for offshore spills in the Nome area. Local boats are available in Nome that could be used for both local transportation and as working platforms at the spill site. Large barges available locally would be the most satisfactory working platforms

because oceanographic conditions during some periods would prohibit use of small boats. The beaches in the Nome area are low and sandy which severely limits access to the water from the shorelines, even though a road system runs along portions of the shoreline.

Mission Profile (Winter)

Primary Transportation Response

The primary transportation response would not change significantly from summer to winter.

Secondary Transportation

The annual sea ice in the Nome area virtually suspends local navigation. Launches can proceed through the looser-packed floe ice during calm weather, but slow speed and maneuverability are essential.[1] Native boats could provide limited transportation of personnel and equipment. Amphibious All Terrain Vehicles or Surface Effect Vehicles would be invaluable for secondary transportation during the winter because they can also serve as working platforms. Helicopters are the only alternative if ATV's or SEV's are unavailable. Travel along the shoreline is much easier in winter than in summer.

Discussion

Darkness and the unstable nature of seasonal sea ice will make operations far offshore very hazardous during the winter. Personnel should not be on the ice unless a means for rapid evacuation is immediately available. The most suitable evacuation vehicle at present is the helicopter. Up to three HH-3F helicopters would be required to support winter operations of 25 personnel for 25 days because of the need to ferry the personnel back and forth for food and shelter.

Conclusions

Response to open water spills within 10 hours (summer) or spills on pack ice within 24 hours (winter) is felt to be beyond present Coast Guard capability due to lack of suitable secondary transportation vehicles. The great distance from the supply base (assumed to be at Kodiak or Anchorage) is a major constraint to response to open water spills within 10 hours.

Requirements to Supplement Capability

The following changes would improve response capability to spills offshore Nome:

1. Locate a supply base nearer to the area
2. Station an SEV in the area
3. Develop air-drop capability for equipment
4. Obtain air-transportable ATV's
5. Schedule an ice-breaker in the area during the winter
6. Enlist the aid of military aircraft from Anchorage or Fairbanks

5.2.9 Offshore Cape Blossom (Kotzebue)

Figure 5-9 shows the Kotzebue area.

Area Characteristics

Distance from Supply Base

Kodiak:

Air - 800 nm

Sea - 1,800 nm

Anchorage:

Air - 650 nm

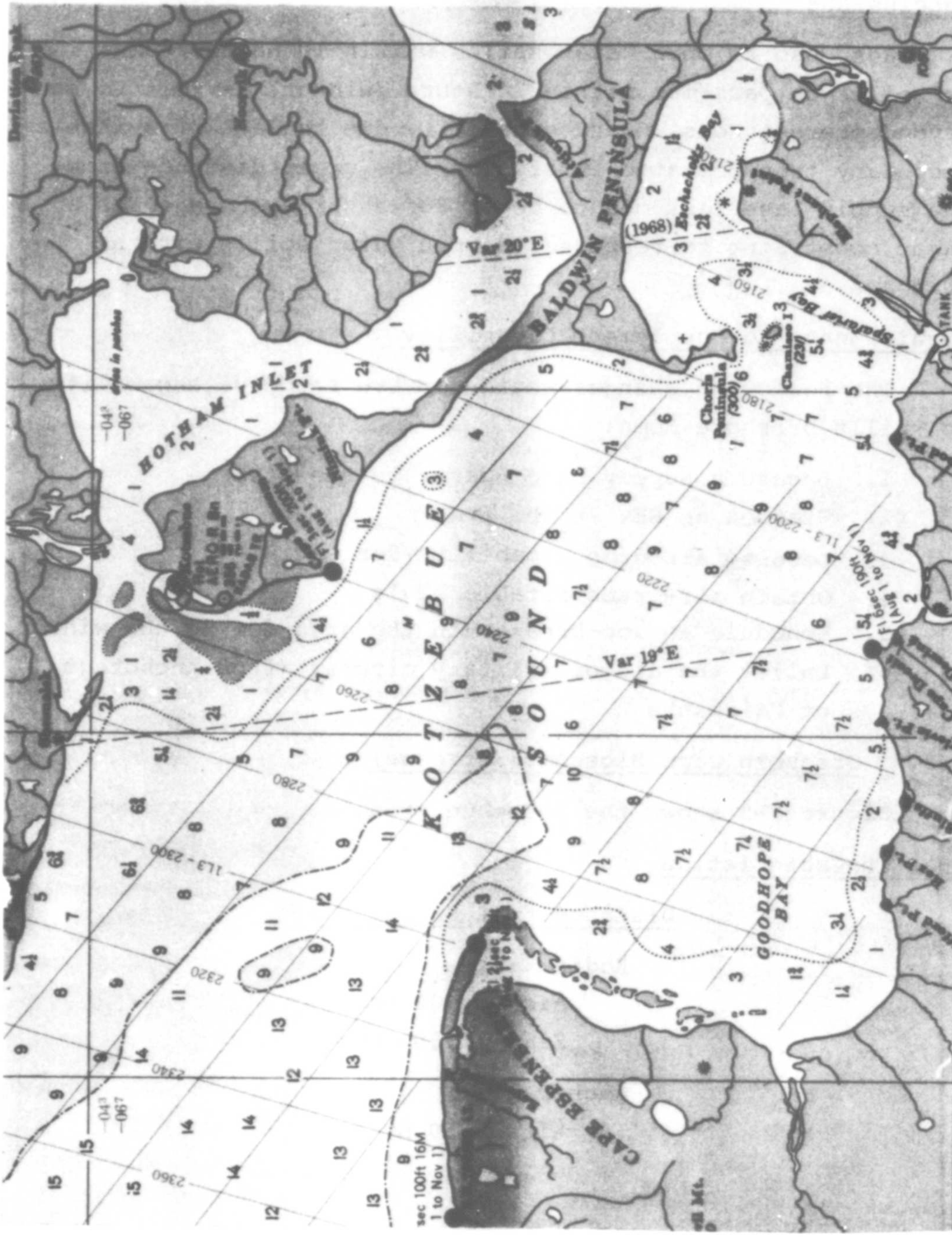

FIGURE 5-9. OFFSHORE CAPE BLOSSOM (Kotzebue) (from C.&G.S. Chart 9402)

Local Airports

The only suitable airfield in the Kotzebue area is the Ralph Wein Memorial Airport approximately one mile from town. Features of the airport include:

	Yes	No
Suitable for HC-130 operations	X	
JP fuel available		X
Instrument landing equipment	X	
Seasonal restrictions		X
Aircraft shelter and maintenance	X	

Local Field and Personnel Support Available

The city of Kotzebue (population ∿1,700) is the only large settlement within a radius of approximately 200 miles. The availability of logistic support functions is tabulated below:

	Yes	No
Quarters	X	
Commissary	X	
Vehicle fuel	X	
Road system		X
Loading pier		X
Medical services	X	
Long range communications	X	

Mission Profile (Summer and Winter)

Primary and secondary transportation considerations are the same as those discussed for offshore Nome in the preceeding section (Section 5.2.8) with the exceptions discussed below. The primary transportation response time is slightly longer because Kotzebue is approximately 75 miles farther from Kodiak. Deep-draft vessels normally approach Kotzebue as closely as possible (approximately 15 miles) and lighter their freight ashore.(1) The facilities in town where the lighters are loaded and unloaded is felt to be the most satisfactory staging area. There is no local road system. JP fuel is not available in Kotzebue and would therefore have to be brought in from outside to sustain helicopter operations.

Discussion

The very shallow waters extending for miles offshore would limit the effectiveness of vessels with drafts exceeding 5 or 6 feet as working platforms. Barges available locally would serve well as working platforms. The same emergency evacuation capability discussed in the preceeding section would apply to operations on the ice during the winter.

Conclusions

Same as Section 5.2.8 (Offshore Nome).

Requirements to Supplement Capability

Same as Section 5.2.8 (Offshore Nome).

5.2.10 Offshore Prudhoe Bay

Figure 5-10 shows the Prudhoe Bay area of the North Slope.

Distance from Supply Base

Kodiak:

- Air - 1,000 nm
- Sea - 2,400 nm

Anchorage:

- Air - 750 nm
- Road - 850 nm

Local Airports

Deadhorse and Prudhoe Bay are the only local airports suitable for operation of large aircraft. Both are located within a few miles of each and the shoreline of Prudhoe Bay. The Deadhorse Airport is better equipped. Features include:

	Yes	No
Suitable for HC-130 operations	X	
JP fuel available	X	
Instrument landing equipment	X	
Seasonal restrictions		X
Aircraft shelter and maintenance		X

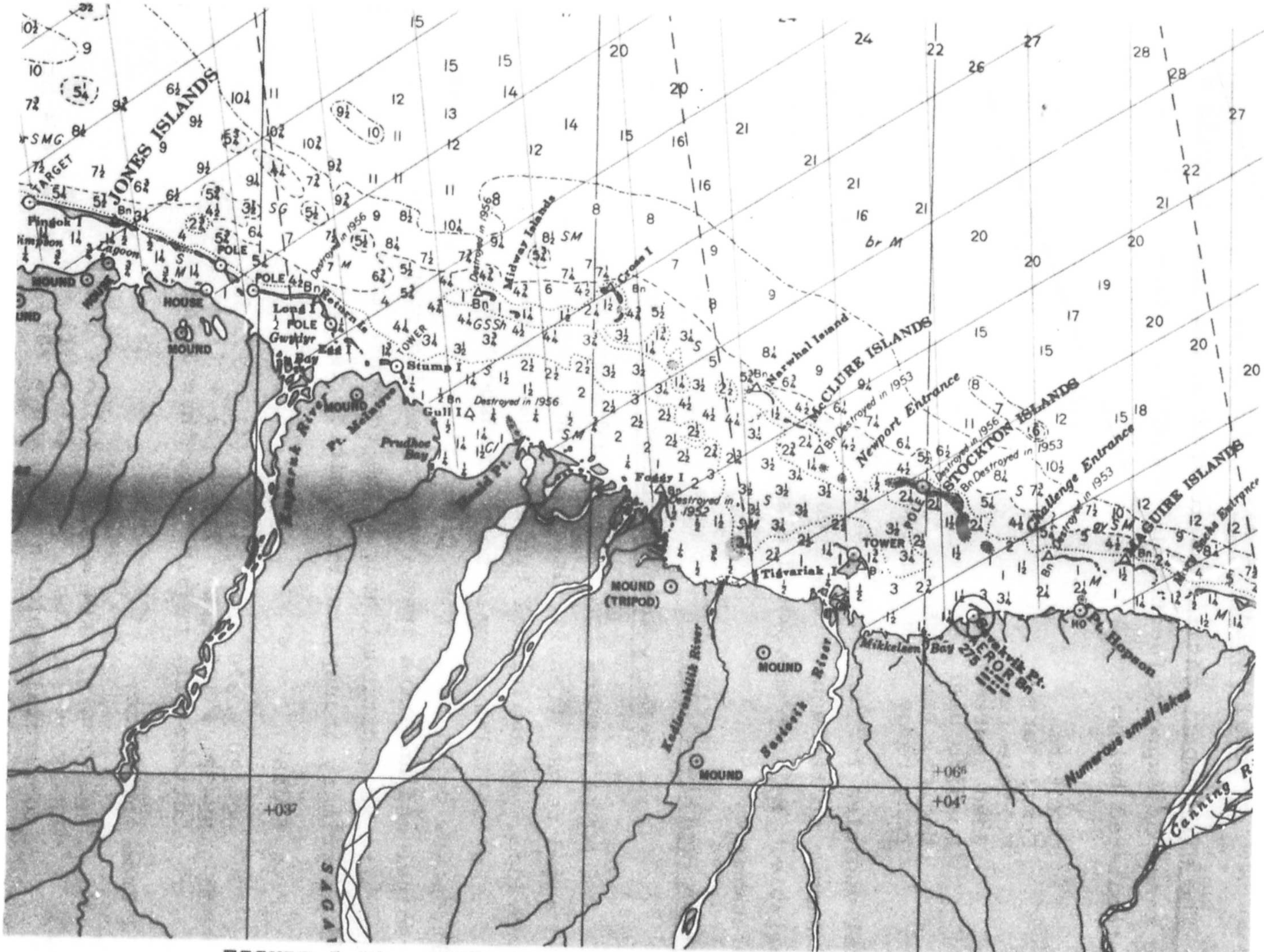

FIGURE 5-10. PRUDHOE BAY (from C.&G.S. Chart 9403)

Local Field and Personnel Support

The oil company facilities at Prudhoe Bay could provide a wide range of support functions. Support functions available are tabulated below:

	Yes	No
Quarters	X	
Commissary	X	
Vehicle fuel	X	
Road system	X	
Loading pier	X	
Medical services	X	
Long range communications	X	

Local vehicles for use on the established road system during the summer or throughout the area in the winter would also be available. Helicopters would also likely be available during the summer.

Mission Profile (Summer)

Primary Transportation Response

Two hours assumed for loading and securing personnel have been added to the transit time of each potential mode of conveyance. An additional two hours have been added for unloading of vehicles assumed to be transporting equipment. Helicopters could be ferried from Kodiak if carrying very few personnel and an extra crew. The refueling stop is assumed to require an additional hour. The response times for the various primary transportation vehicles is as follows:

From Kodiak:

HC-130 @ 320 Kts = 3.1 + (4) = 7.1 hrs
HH-3F @ 128 Kts = 7.8 + (2) + (1) = 10.8 hrs
Cutters will require more than 3 days

From Anchorage:

HC-130 @ 320 Kts = 2.3 + (4) = 6.3 hrs
HH-3F @ 128 Kts = 5.9 + (2) + (1) = 8.9 hrs
Commercial Vehicles @ 50 mph = 20.4 + (4) = 24.4 hrs

Secondary Transportation

Coast Guard vessels would normally not be available at Prudhoe Bay. Helicopters from the supply base would be the most suitable vehicle for local personnel transport to and from the spill site. Barges and shallow draft boats available locally would also be required for equipment transfer and personnel transport. The Prudhoe dock facilities can accomodate vessels with drafts up to approximately six feet and would be the most suitable local staging area. Travel along the Prudhoe Bay shoreline is virtually impossible during the summer due to tundra conditions.

Mission Profile (Winter)

Primary transportation considerations would be the same as those for summer except that aircraft would have to be operable in temperatures of at least -50°F. Secondary transportation to and from a spill on the moving pack ice several miles offshore for up to 20 men and a large volume of equipment would be very difficult in the winter darkness. Local vehicles probably will not be satisfactory for operations on the pack ice. Thus, helicopters or some type of land vehicles air-lifted to Prudhoe Bay by the Coast Guard would be required.

Discussion

Equipment for marine oil spill cleanup operations will be available from the oil companies at Prudhoe Bay. The oil companies will be drilling on the offshore islands in the near future. Use of oil company equipment would reduce the weight of Coast Guard equipment to be transported and possibly eliminate the need for an extra HC-130 for primary transportation of men and equipment. Coast Guard icebreakers operating within 200 to 400 nautical miles of Prudhoe Bay would be

invaluable for rapid oil spill response because of the helicopter available and the suitability as a working platform on the ice.

Conclusions

Response to open water spills (summer) within 10 hours or spills on pack ice (winter) within 24 hours is felt to be beyond present Coast Guard capability. Major constraints are the great distance from assumed supply bases (for open water spills) and a lack of suitable secondary transportation vehicles for travel over pack ice and the possibility of temperatures below the range in which Coast Guard aircraft can safely operate.

Requirements to Supplement Capability

The following changes would improve response capability to spills offshore Prudhoe Bay:

1. Locate a supply base nearer to the area
2. Station an SEV in the area
3. Develop air-drop capability for equipment
4. Obtain air-transportable ATV's
5. Convert aircraft for extreme low temperature operation
6. Enlist the aid of military aircraft from Anchorage or Fairbanks

5.2.11 Onshore Prudhoe Bay

The discussion of area characteristics, primary transportation, and requirements to supplement capability for oil spills offshore at Prudhoe Bay (Section 5.2.10) would generally apply to oil spills onshore in the Prudhoe Bay area. However, it is felt that the desired response within 24 hours can be met for onshore spills during the winter and in the summer at most locations. Response is felt possible because of the road

system developed throughout the area and the fact that off-road vehicles would be available from oil industry sources for winter operations. Restrictions on summer travel over the tundra could be overcome by combined use of commercial vehicles on existing roads and helicopters.

5.2.12 Umiat

Figure 5-11 shows the area surrounding Umiat.

Area Characteristics

Distance from Supply Base

Kodiak:

Air - 900 nm

Anchorage:

Air - 650 nm

Local Airport

The only suitable airfield within a 70 mile radius is located in Umiat. An airstrip at Prince Creek approximately 25 miles to the west could be used part of the year with lighter aircraft. Features of the Umiat airfield are as follows:

	Yes	No
Suitable for HC-130 operations	X	
JP fuel available		X
Instrument landing equipment		X
Seasonal restrictions	X	
Aircraft shelter or maintenance		X
Runway lighting	X	

Seasonal restrictions are due to a complete lack of runway maintenance (i.e., no snow removal, etc).

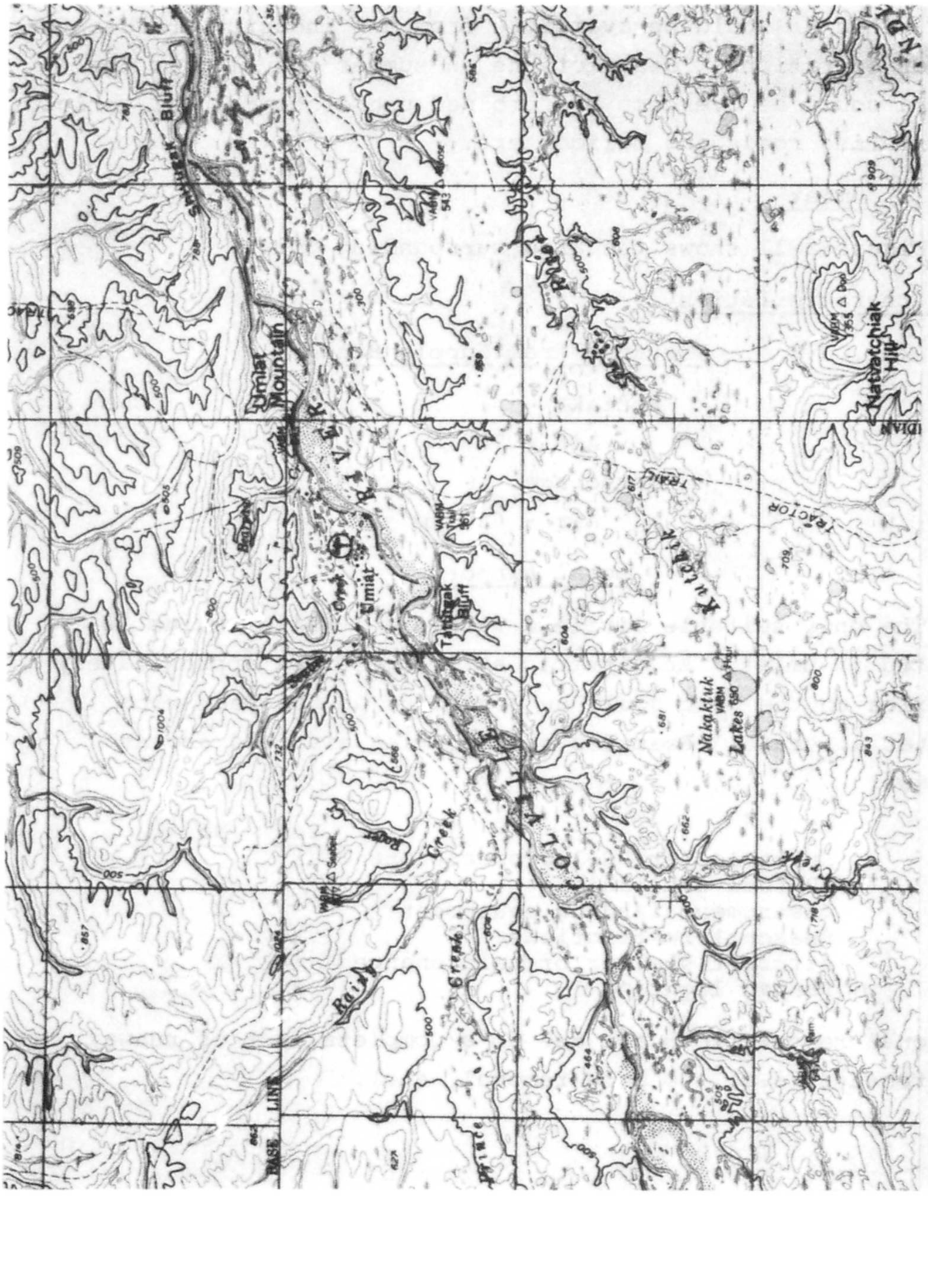

FIGURE 5-11. UMIAT (from U.S.G.S. Alaska Topographic Series)

Local Field and Personnel Support Available

Umiat is a location rather than a city. There are no local inhabitants. Extremely limited amounts of fuel and equipment stockpiled by the NPR #4 operations office are located at the airport. No roads exist and vehicles are not known to be available.

Mission Profile (Summer)

Primary Transportation Response

Two hours assumed for loading equipment and securing personnel have been added to the transit time of each potential mode of conveyance. An additional two hours has been added for the unloading of vehicles assumed to be transporting equipment. Helicopter transit times assume a one hour refueling stop in Fairbanks. The response time for various primary transportation vehicles is as follows:

From Kodiak:

HC-130 @ 320 Kts = 2.8 + (4) = 6.8 hrs
HH-3F @ 128 Kts = 7 + (2) + (1) = 10.0 hrs

From Anchorage:

HC-130 @ 320 Kts = 2.0 + (4) = 6.0 hrs
HH-3F @ 128 Kts = 5.1 + (2) + (1) = 8.1 hrs

Secondary Transportation

Secondary transportation in the Umiat area is limited to helicopters, ATV's, or SEV's. Any land vehicle used would have to be amphibious due to abundant lakes and the possible requirement to ford the Colville River. Tractor trails have been established throughout the area which, presumably, take advantage of the most favorable terrain for overland travel. Rolligons have been used successfully in this area by the NPR #4 operations office. Helicopters would be required for emergency response or rapid travel.

Mission Profile (Winter)

Primary transportation aircraft such as HC-130 could not use the Umiat runway during the winter without prior reconnaissance by light aircraft. A portable tower would greatly facilitate landing operations. Snow conditions could restrict landing to aircraft equipped with skis. The aircraft would further have to be capable of operation in temperatures of -50°F or colder.

Secondary Transportation

The same general types of land vehicles would be required as in the summer, except that capability to traverse snow rather than water and tundra would be required. Small Caterpillar tractors (D-4 and D-6) have been air-dropped and would provide satisfactory overland capability for pulling sleds during the winter.

Discussion

The only satisfactory staging area is the Umiat airfield. Umiat is, by far, the most remote and inaccessible of the selected sites chosen for the study. There is little or no possibility of response within 24 hours if the visibility or weather conditions preclude aircraft landings. All personnel support functions and transportation vehicles must be carried to the site. The only shelter available is one unheated building at the airfield. Oil spills that reach the Colville River would probably move as fast as secondary transportation vehicles (except helicopters). All fuel for field operations would have to be brought in from outside.

Conclusions

It is doubtful that response to a spill site outside the immediate area of Umiat could be accomplished within 24 hours during the summer due to lack of adequate secondary

transportation vehicles and the long distance from the supply base. Response within 24 hours during the winter is very unlikely due to both primary and secondary transportation constraints. Long range communications would present a serious problem.

<u>Requirements to Supplement Capability</u>

The following changes would improve response capability:

1. Locate a supply base nearer to the area
2. Develop air-drop capability for equipment
3. Enlist the aid of military aircraft from Fairbanks
4. Obtain air-transportable ATV's
5. Obtain portable shelters and messing facilities

5.2.13 Yukon River TAPS Crossing

The stretch of Yukon River that the Trans-Alaska Pipeline will cross is shown in Figure 5-12.

<u>Area Characteristics</u>

<u>Distance from Supply Base</u>

Kodiak:

Air - 650 nm

Anchorage:

Air - 375 nm

Road - 500 nm

<u>Local Airports</u>

No suitable airports or landing strips for large aircraft are located within a 50 mile radius of the Yukon River TAPS Crossing. Small landing strips at Rampart (2,500 feet long) and Five Mile Camp (2,500 feet long) might be used for transport of personnel in light planes. Rampart is approximately

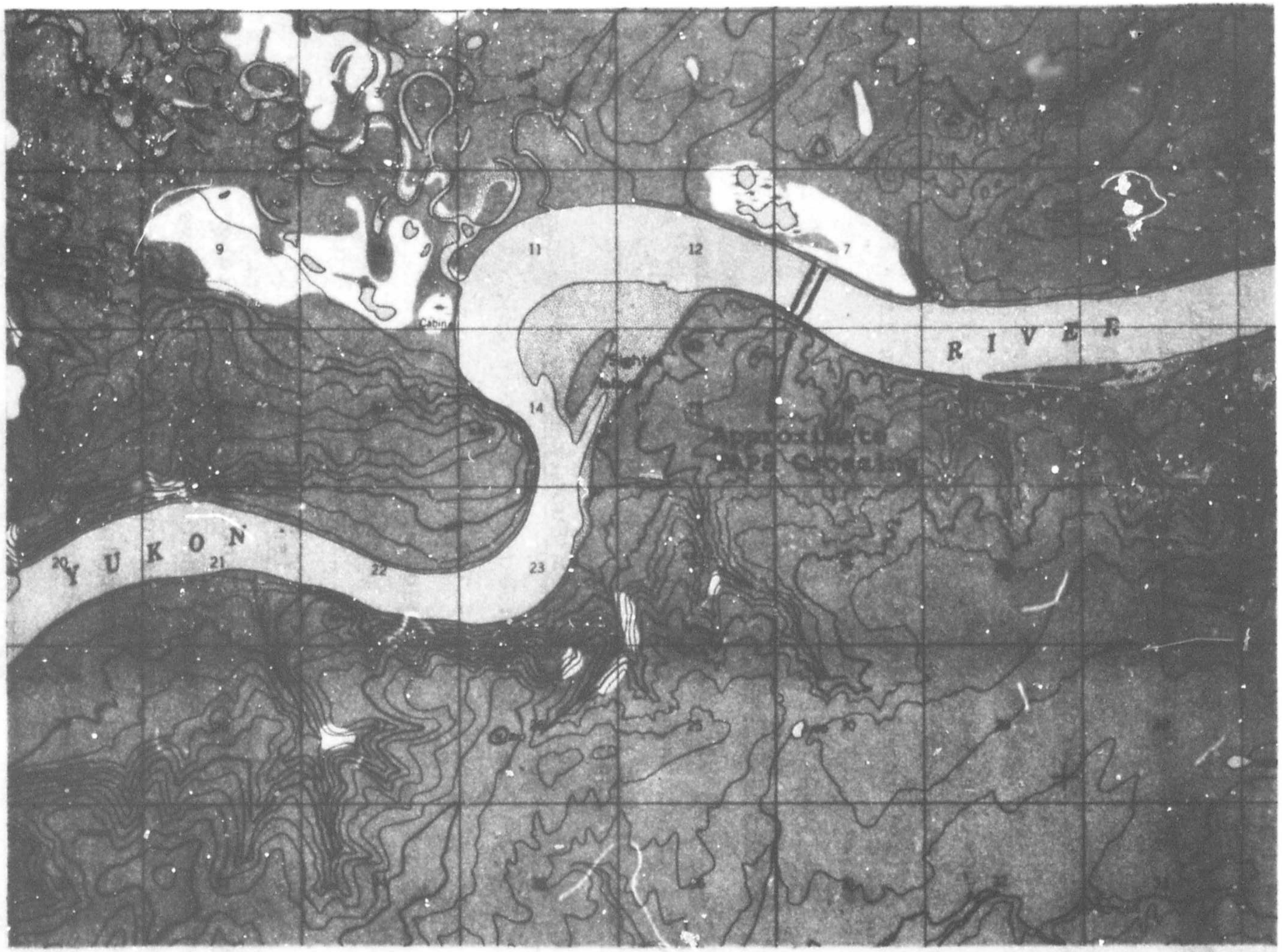

FIGURE 5-12. YUKON RIVER TAPS CROSSING (from U.S.G.S Alaska Topographic Series)

30 miles away downstream and might serve as a staging area if the postulated oil spill reached the Yukon River. Five Mile Camp is 5 miles from the TAPS crossing. Both airfields are suited to daylight use only.

<u>Local Field and Personnel Support Available</u>

Every necessary type of field support is available in Fairbanks approximately 100 miles away and connected by road. Military facilities in Fairbanks are the best source of supplies, equipment, and vehicles. A TAPS pumping station will be located near the river crossing and could provide limited support. Limited support might also be available in small towns along the road to Fairbanks.

<u>Mission Profile (Summer and/or Winter)</u>

The transportation considerations will change somewhat from summer to winter. However, the advantages of daylight in summer are felt to be offset by the easier travel over frozen ground in the winter.

<u>Primary Transportation Response</u>

The nearest suitable airport is at Fairbanks. Aircraft for primary transportation would be used only if the supply base were at Kodiak. Response time of the various modes of conveyance (including loading and unloading) are as follows:

Kodiak - Fairbanks:

HC-130 @ 320 Kts = 1.8 + (4) = 5.8 hrs
HH-3F @ 128 Kts = 4.5 + (2) = 6.5 hrs

Anchorage to spill location:

Conventional land vehicle
@ 40 mph = 15.0 + (4) = 19.0 hrs
HH-3F @ 128 Kts = 3.9 + (2) = 5.9 hrs

Fairbanks to spill location:

Conventional land vehicle
@ 40 mph = 3.0 + (4) = 7.0 hrs
HH-3F @ 128 Kts = 0.7 + (2) = 2.7 hrs

Secondary Transportation

The general area surrounding the postulated spill is relatively low and well-drained hills. The entire area should be accessible by tracked vehicles during the summer or winter. Military off-road vehicles from bases in Fairbanks could be at the site in approximately 5 hours. Shallow draft boats would be required if the oil reached the Yukon River. Small craft such as outboard-powered Boston Whalers would suffice for local transportation during the summer. Larger boats are desirable for working platforms. The surface of the Yukon is frozen during the winter and would best be avoided for local transportation. HH-3F helicopters could provide personnel transportation.

Discussion

The exact classification of a spill near the Yukon River TAPS crossing is debatable within the study framework between tundra, open water, and shorefast ice. It will be assumed that the classification is not that of open water and the desired response time is accordingly 24 hours. The highway bridge presently being constructed across the Yukon at the pipeline crossing will greatly facilitate secondary transportation for spills on land by eliminating the need for boats.

Conclusions

Response can be completed within 24 hours in summer or winter to this area from either Kodiak or Anchorage. The response would require between 10 and 12 hours under ideal

conditions. Secondary trasnportation other than helicopters would have to be provided by agencies other than the Coast Guard. Extreme cold winter temperatures could delay the response beyond 24 hours if the transportation equipment is not operable at these temperatures. All "hotel" functions such as food and shelter would have to be brought to the site from outside. The best staging area would probably be the TAPS pumping station because long range communications would be available.

Requirements to Supplement Capability

The following changes would improve response capability:

1. Air-drop capability for all equipment
2. Enlisting the aid of military organizations in the Anchorage or, particularly, the Fairbanks area
3. Procurement of portable shelters and messing facilities

5.2.14 Denali Fault TAPS Crossing

Figure 5-13 includes the general area where the pipeline crosses the Denali Fault. The fault zone crosses the Richardson Highway approximately midway between Paxson and Donnelly.

Area Characteristics

Distance from Supply Base

Kodiak:

Air - 525 nm

Anchorage:

Air - 225 nm
Road - 300 nm

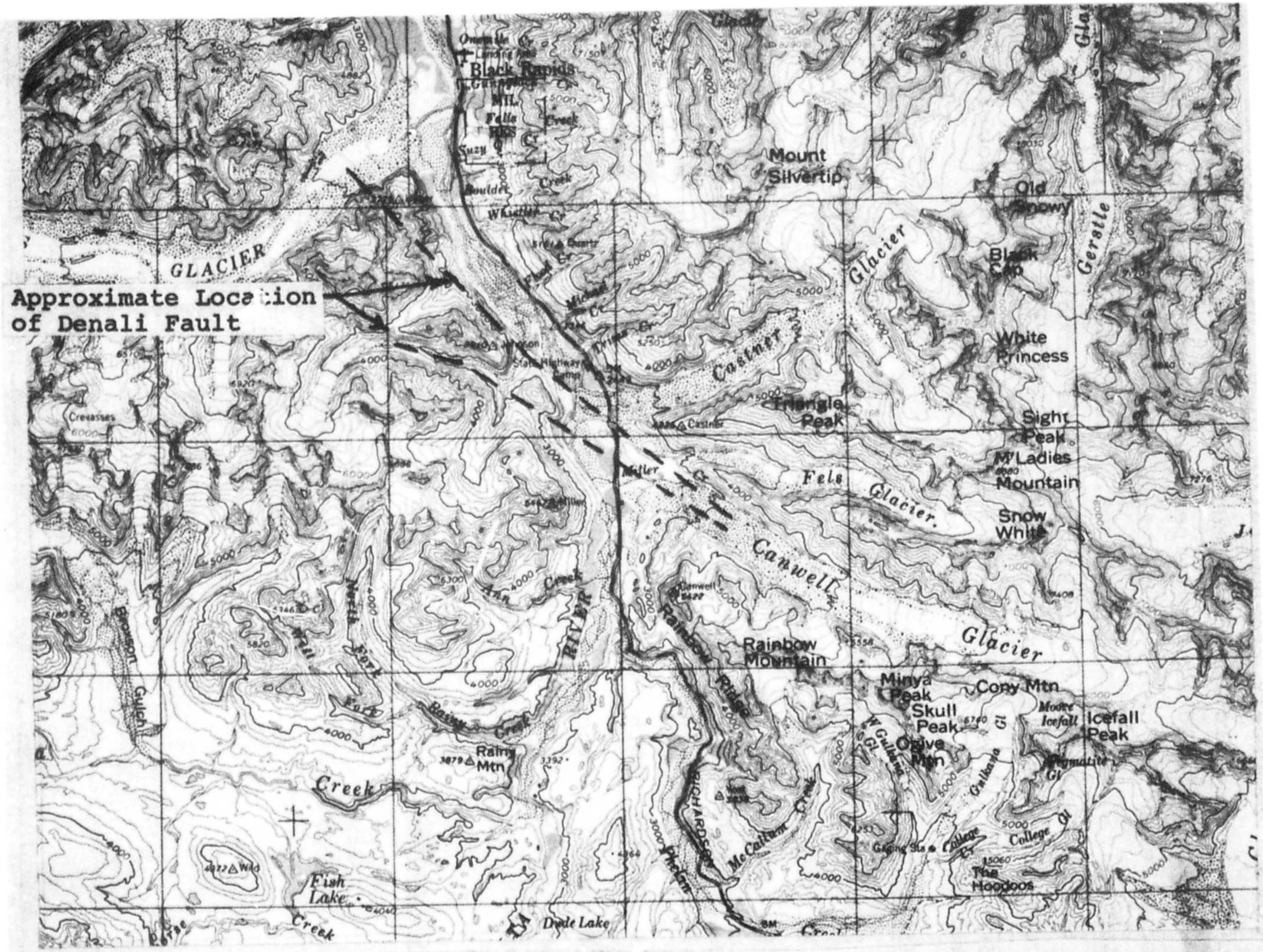

FIGURE 5-13. DENALI FAULT TAPS CROSSING (from U.S.G.S. Alaska Topographic Series)

Local Airports

The nearest airfield suitable for large aircraft is Allen Army Airfield at Fort Greely (approximately four miles from Delta Junction). Local airstrips under 2,400 feet in length that could be used for personnel transport in light planes are located at Black Rapids, Paxson and Summit Lake. Features of Allen AAF include:

	Yes	No
Suitable for HC-130 operations	X	
JP fuel available	X	
Instrument landing equipment	X	
Seasonal restrictions		X
Aircraft maintenance and shelter	X	

Local Field and Personnel Support Available

Fort Greely near Delta Junction is the best source of logistic backup support. Supplies, equipment, personnel and vehicles should be readily available. Fort Greely is approximately 50 miles from the postulated spill area.

Mission Profile (Summer and/or Winter)

Primary Transportation Response

Large transport aircraft from Anchorage would offer little advantage over road vehicles. The times for loading, unloading, and securing of personnel added to vehicle transit times are the same used in preceeding site discussions. Response times for the various primary transportation vehicles is as follows:

From Kodiak to Fort Greely:

HC-130 @ 320 Kts = 1.8 + (4) = 5.8 hrs
HH-3F @ 128 Kts = 4.5 + (2) = 6.5 hrs

From Anchorage to site:

HH-3F @ 128 Kts = 1.8 + (2) = 3.8 hrs
Commercial vehicle
@ 40 mph = 6 + (4) = 10.0 hrs

From Fort Greely to site:

HH-3F @ 128 Kts = 0.3 + (2) = 2.3 hrs
Military transport vehicle
@ 30 mph = 1.7 + (4) = 5.7 hrs

Secondary Transportation

Standard commercial vehicles will suffice for most access. Very powerful off-road vehicles would permit traversing of the steep slopes between the Richardson Highway and the Delta River Valley. Amphibious vehicles will be required to operate on and along the river. Helicopters could serve for airlift over distances of less than one mile across areas that land vehicles could not traverse. Surface Effect Vehicles would be of little value in this steep, rugged terrain. Standard sedans and pickups could transport personnel to within one mile of the oil spill throughout the area.

Discussion

The Trans-Alaska Pipeline will essentially parallel the existing Richardson Highway throughout the Denali Fault area. All oil lost from a pipeline break would drain to the Delta River basin. The Delta River flows northward in this region. River ice during the winter would facilitate access because the flowing river is exceedingly difficult to navigate. The Richardson Highway is within one mile of the Delta River throughout most of the area.

Conclusions

Response within 10 hours to the selected spill area is possible if support is enlisted from the Army at Fort Greely. Personnel could essentially move back and forth from the staging area at Fort Greely, although a closer staging area might be established along the Richardson Highway.

Requirements to Supplement Capability

The following changes would improve response capability:

1. Air-drop capability for all equipment
2. Enlistment of logistic support from Fort Greely

5.2 REFERENCES CITED

1. U.S. Dept. of Commerce, Coast and Geodetic Survey, United States Coast Pilot 9 - Pacific and Arctic Coasts. Seventh (1964) edition.

APPENDIX A-1

AIRCRAFT

AIRCRAFT TYPE/CLASS: HC-130H and other models

SERVICE CATEGORY(S): Primary transportation

STATUS: Operational

OWNER/OPERATOR: US Coast Guard, Air Force, private industry

APPROXIMATE NUMBER AVAILABLE IN ALASKA: 4/5 (Coast Guard), ∿50 within Alaska

GEOGRAPHIC LOCATION(S): Kodiak and Sitka (Coast Guard),
Anchorage and Fairbanks

CARGO OR LIFT CAPACITY (volume/weight): ∿45,000# max. 9' x 10' x 40'

MAXIMUM SINGLE CARGO PACKAGE (dimensions): ∿8' x 5' x 20' / 15,000#

CARGO HANDLING FEATURES OR RESTRICTIONS: (containerization, air drop, etc.) Air drop. Metric dual rail cargo handling system (-4A)

SPEED: MAXIMUM 320 kts **CRUISE** 290 kts

OPERATING RANGE: AT MAXIMUM SPEED <2,000 **AT CRUISE SPEED** ∿2,100 nm

FUEL TYPE REQUIRED: JP 3, 4 or 5

FUEL CONSUMPTION: MAXIMUM 5,000 #/hr **CRUISE** ∿3,600 #/hr

WEIGHT: GROSS 155,000# **EMPTY** 75,000#

NORMAL CREW: Seven

PASSENGER LIMIT: ∿50

OPERATIONAL LIMITATIONS DUE TO ENVIRONMENT (ranges of weather conditions, weather minimums for landing, etc.): Standard Transport Restrictions

AIRCRAFT TYPE/CLASS (contd): HC-130H

RUNWAY REQUIREMENTS (length, condition, etc.):

4,000 - 4,200' unprepared

TIEDOWN REQUIREMENTS: Winds above 50 kts

FIELD MAINTENANCE AND/OR SUPPORT REQUIREMENTS FOR NORMAL AND EXTENDED OPERATION:

Minimal

COMMUNICATIONS AND NAVIGATION EQUIPMENT ON BOARD:

UHF, VHF, VHF/FM,HF,LF receives, VORTAC, LORAN A & C, INS, AYN 1

APPROXIMATE OPERATING COST: $1,000/hr

COMPARATIVE RELIABILITY OR ADAPTABILITY FOR ARCTIC OPERATION:

Excellent. Highest of available Coast Guard aircraft. Flown year-round in the Arctic for many years. Can be ski-equipped

NARRATIVE DESCRIPTION AND/OR COMMENTS:

The Hercules is undoubtedly the most versatile large cargo transport aircraft available in Alaska. The HC-130H Model is used for long-range Search and Rescue, fishery patrols and logistic support of outlying Coast Guard Stations. The HH-3F helicopter can be refueled directly from the HC-130H as both aircraft use the same type of JP fuel. The air drop capability is used frequently to drop pumps and other equipment to stricken fishing vessels. The Arctic reliability of the Hercules was proven during 1968 and 1969 when transports averaging 22 tons each carried supplies around the clock between Fairbanks and Prudhoe Bay.

AIRCRAFT TYPE/CLASS: HH-52A Helicopter

SERVICE CATEGORY(S): Secondary Transportation

STATUS: Operational

OWNER/OPERATOR: U.S. Coast Guard and others

APPROXIMATE NUMBER AVAILABLE IN ALASKA: Varies from 0 to a few

GEOGRAPHIC LOCATION(S): Operate from ships at sea

CARGO OR LIFT CAPACITY (volume/weight): ∿1,000#

MAXIMUM SINGLE CARGO PACKAGE (dimensions): No restrictions

CARGO HANDLING FEATURES OR RESTRICTIONS: (containerization, air drop, etc.) 3,000# cargo sling, 600# hoist

SPEED: MAXIMUM 110 knots CRUISE 85 knots

OPERATING RANGE: AT MAXIMUM SPEED -- AT CRUISE SPEED ∿360 nm

FUEL TYPE REQUIRED: JP-4, JP-5

FUEL CONSUMPTION: MAXIMUM CRUISE 400-425 #/hr

WEIGHT: GROSS 8,300# EMPTY 5,600#

NORMAL CREW: 3

PASSENGER LIMIT: ∿4

OPERATIONAL LIMITATIONS DUE TO ENVIRONMENT (ranges of weather conditions, weather minimums for landing, etc.): Limited primarily due to lack of navigation gear.

AIRCRAFT TYPE/CLASS (contd): HH-52A Helicopter

RUNWAY REQUIREMENTS (length, condition, etc.): N/A

TIEDOWN REQUIREMENTS: --

FIELD MAINTENANCE AND/OR SUPPORT REQUIREMENTS FOR NORMAL AND EXTENDED OPERATION:
Minimal

COMMUNICATIONS AND NAVIGATION EQUIPMENT ON BOARD: Communications very adequate. Navigation equipment limited

APPROXIMATE OPERATING COST: ~$250/hr

COMPARATIVE RELIABILITY OR ADAPTABILITY FOR ARCTIC OPERATION:
Very good. Have been used with icebreakers in the Arctic for many years.

NARRATIVE DESCRIPTION AND/OR COMMENTS:

AIRCRAFT TYPE/CLASS: HH-3F (Pelican) Helicopter

SERVICE CATEGORY(S): Primary transport of personnel, secondary transportation

STATUS: Operational

OWNER/OPERATOR: U. S. Coast Guard

APPROXIMATE NUMBER AVAILABLE IN ALASKA: 4 - 6

GEOGRAPHIC LOCATION(S): Kodiak, Sitka (future)

CARGO OR LIFT CAPACITY (volume/weight): ~4,000#

MAXIMUM SINGLE CARGO PACKAGE (dimensions): No restrictions

CARGO HANDLING FEATURES OR RESTRICTIONS: (containerization, air drop, etc.) 8,000# external cargo sling, 600# capacity hoist

SPEED: MAXIMUM ~135 knots CRUISE 125-128 knots

OPERATING RANGE: AT MAXIMUM SPEED -- AT CRUISE SPEED up to 748 nm

FUEL TYPE REQUIRED: JP 4 or 5

FUEL CONSUMPTION: MAXIMUM -- CRUISE ~1,200 #/hr

WEIGHT: GROSS 22,050# EMPTY 13,400#

NORMAL CREW: 2 or 3

PASSENGER LIMIT: ~20

OPERATIONAL LIMITATIONS DUE TO ENVIRONMENT (ranges of weather conditions, weather minimums for landing, etc.): Standard transport restrictions

AIRCRAFT TYPE/CLASS (contd): HH-3F (Pelican) Helicopter

RUNWAY REQUIREMENTS (length, condition, etc.): N/A

TIEDOWN REQUIREMENTS: --

FIELD MAINTENANCE AND/OR SUPPORT REQUIREMENTS FOR NORMAL AND EXTENDED OPERATION:
Minimal

COMMUNICATIONS AND NAVIGATION EQUIPMENT ON BOARD: Complete and adequate for Alaskan operation

APPROXIMATE OPERATING COST: ~$500/hr

COMPARATIVE RELIABILITY OR ADAPTABILITY FOR ARCTIC OPERATION:
Very good. Similar helicopters have been operated by the Air Force throughout the Arctic for many years.

NARRATIVE DESCRIPTION AND/OR COMMENTS:

APPENDIX A-2

VESSELS

SHIP TYPE/CLASS: Large Patrol Craft (WPB)

SERVICE CATEGORY(S): Primary/secondary transport, field support

STATUS: Operational

OWNER/OPERATOR: US Coast Guard

APPROXIMATE NUMBER AVAILABLE IN ALASKA: 4

GEOGRAPHIC LOCATION(S): Juneau, Ketchikan, Petersburg, Seward

DECK CAPACITY (area/weight): 20,000 #/1,300 ft^3

HOLD CAPACITY (volume/weight): very limited

CARGO HANDLING FEATURES OR RESTRICTIONS:
(containerization, deck winches):

SPEED: MAXIMUM 20 kts STANDARD 12 kts

OPERATING RANGE: AT MAXIMUM SPEED AT STANDARD SPEED ∿1200 nm

FUEL TYPE REQUIRED: Diesel

DIMENSIONS: DRAFT 6' LOA 95' BEAM 19'

STANDARD DISPLACEMENT: 98-105 tons

NORMAL COMPLEMENT: 14 - 1 officer, 13 enlisted

ADDITIONAL PERSONNEL SUPPORT CAPABILITY: <20

OPERATIONAL LIMITATIONS DUE TO ENVIRONMENT (ranges of weather and ice conditions, minimum water depth, etc.):

∿10-foot water depth
not ice-reinforced

SHIP TYPE/CLASS (contd): Large Patrol Craft

AUXILIARY VESSELS AND/OR AIRCRAFT CARRIED: One small launch

AUXILIARY EQUIPMENT (pumps, hoses, etc.):
1 pump, 200-ft fire hose

DOCKING OR MOORING LIMITATIONS: None. Twin screw

FIELD MAINTENANCE AND SUPPORT REQUIREMENTS FOR EXTENDED OPERATION:
Minimal maintenance. Classed as Short Endurance Cutter - 1 to 15 days at sea without support.

COMMUNICATIONS AND NAVIGATION EQUIPMENT ON BOARD (range, frequency, etc.):
Complete and adequate for Alaskan operation

APPROXIMATE OPERATING COST: ~ $75/hr

COMPARATIVE RELIABILITY OR ADAPTABILITY FOR ARCTIC OPERATION: Relatively poor

NARRATIVE DESCRIPTION AND/OR COMMENTS:

SHIP TYPE/CLASS: Seagoing Buoy Tender, WLB(WOBT)

SERVICE CATEGORY(S): Primary/secondary transport, field support

STATUS: Operational

OWNER/OPERATOR: US Coast Guard

APPROXIMATE NUMBER AVAILABLE IN ALASKA: 6 or 7

GEOGRAPHIC LOCATION(S): Adak, Ketchikan, Kodiak, Sitka, Homer, Cordova, Juneau

DECK CAPACITY (area/weight): 2250 ft^2/100,000 #

HOLD CAPACITY (volume/weight): Much less than deck

CARGO HANDLING FEATURES OR RESTRICTIONS: Boom capacity 20 tons
(containerization, deck winches):

SPEED: MAXIMUM 12.5 kts STANDARD 12.0 kts

OPERATING RANGE: AT MAXIMUM SPEED 2000 nm AT STANDARD SPEED ~ 2500 nm

FUEL TYPE REQUIRED: Diesel

DIMENSIONS: DRAFT 12'-6" mean LOA 180' BEAM 37'

STANDARD DISPLACEMENT: 935 standard, 1025 full load (tons)

NORMAL COMPLEMENT: 53 - 6 officers and 47 enlisted

ADDITIONAL PERSONNEL SUPPORT CAPABILITY: Approx. 5 normally. Can be used to evacuate more than 25 personnel.

OPERATIONAL LIMITATIONS DUE TO ENVIRONMENT (ranges of weather and ice conditions, minimum water depth, etc.):

Breaks up to a maximum of 1-1/2 - 2' of ice in continuous running.
18-foot minimum water depth
Full sea keeping capability

SHIP TYPE/CLASS (contd): Seagoing Buoy Tender

AUXILIARY VESSELS AND/OR AIRCRAFT CARRIED: 4 small launches

AUXILIARY EQUIPMENT (pumps, hoses, etc.):

2 pumps, approximately 1200' hose

DOCKING OR MOORING LIMITATIONS: None, Twin screw

FIELD MAINTENANCE AND SUPPORT REQUIREMENTS FOR EXTENDED OPERATION: Minimal-classed as medium endurance - 15 to 30 days at sea without support.

COMMUNICATIONS AND NAVIGATION EQUIPMENT ON BOARD (range, frequency, etc.):

Complete and adequate for Alaskan operations

APPROXIMATE OPERATING COST: $180/hr

COMPARATIVE RELIABILITY OR ADAPTABILITY FOR ARCTIC OPERATION:

Fair. Three of the vessels stationed in Alaska are ice-strengthened.

NARRATIVE DESCRIPTION AND/OR COMMENTS:

SHIP TYPE/CLASS: Medium Endurance Cutter (WMEC)

SERVICE CATEGORY(S): Primary/secondary transportation, field support

STATUS: Operational

OWNER/OPERATOR: US Coast Guard

APPROXIMATE NUMBER AVAILABLE IN ALASKA: 2 stationed in Alaska - STORIS and CONFIDENCE

GEOGRAPHIC LOCATION(S): Kodiak

DECK CAPACITY (area/weight): >2000 ft^2/>> 35,000 lbs

HOLD CAPACITY (volume/weight): Much less than deck

CARGO HANDLING FEATURES OR RESTRICTIONS:
(containerization, deck winches):

SPEED: MAXIMUM 14-18 kts STANDARD 12.2 - 13 kts

OPERATING RANGE: AT MAXIMUM SPEED >5000 nm AT STANDARD SPEED >6000 nm

FUEL TYPE REQUIRED: Diesel, JP-5

DIMENSIONS: DRAFT 10'-5" to 14'-10" LOA 210-230' BEAM 34-43'

STANDARD DISPLACEMENT: 1715 (STORIS), 950 (CONFIDENCE) (tons)

NORMAL COMPLEMENT: 106 (STORIS), 61 (CONFIDENCE)

ADDITIONAL PERSONNEL SUPPORT CAPABILITY: Both WMEC's could support more than 25 additional if necessary.

OPERATIONAL LIMITATIONS DUE TO ENVIRONMENT (ranges of weather and ice conditions, minimum water depth, etc.):

About 20 foot minimum depth. STORIS ice-reinforced and can handle up to about three feet of continuous ice. CONFIDENCE not ice-reinforced.

SHIP TYPE/CLASS (contd): Medium Endurance Cutter

AUXILIARY VESSELS AND/OR AIRCRAFT CARRIED: 2-3 small launches, 1 HH52 helicopter carried on CONFIDENCE

AUXILIARY EQUIPMENT (pumps, hoses, etc.):
Several pumps and >1000 feet of hose

DOCKING OR MOORING LIMITATIONS: None

The STORIS has a single screw. The CONFIDENCE has twin screws.

FIELD MAINTENANCE AND SUPPORT REQUIREMENTS FOR EXTENDED OPERATION:

Minimal - WMEC's are capable of missions up to 15-30 days without support.

COMMUNICATIONS AND NAVIGATION EQUIPMENT ON BOARD (range, frequency, etc.):

Complete and adequate for Alaskan operations.

APPROXIMATE OPERATING COST: ∿ $220/hr

COMPARATIVE RELIABILITY OR ADAPTABILITY FOR ARCTIC OPERATION:

STORIS - good
CONFIDENCE - fair

NARRATIVE DESCRIPTION AND/OR COMMENTS:

SHIP TYPE/CLASS: High Endurance Cutter (WHEC) 378' Class

SERVICE CATEGORY(S): Primary/secondary transportation, field support

STATUS: Operational

OWNER/OPERATOR: US Coast Guard

APPROXIMATE NUMBER AVAILABLE IN ALASKA: Up to 7 from other Districts

GEOGRAPHIC LOCATION(S): Gulf of Alaska and Bering Sea patrols

DECK CAPACITY (area/weight): >> 35,000 lbs and 1000 ft^3

HOLD CAPACITY (volume/weight):

CARGO HANDLING FEATURES OR RESTRICTIONS: no restrictions
(containerization, deck winches):

SPEED: MAXIMUM 29 kts STANDARD 20 kts

OPERATING RANGE: AT MAXIMUM SPEED ~3,000 nm AT STANDARD SPEED 11,500 nm

FUEL TYPE REQUIRED: Diesel

DIMENSIONS: DRAFT 20' LOA 378' BEAM 42

STANDARD DISPLACEMENT: 2716 (std), 3,050 (full load) (tons)

NORMAL COMPLEMENT: Quarters for 17 officers, 152 men and 6 oceanographers

ADDITIONAL PERSONNEL SUPPORT CAPABILITY: > 25 personnel

OPERATIONAL LIMITATIONS DUE TO ENVIRONMENT (ranges of weather and ice conditions, minimum water depth, etc.):

Approximately 30-foot water depth. Not ice-reinforced

SHIP TYPE/CLASS (contd): High Endurance Cutter

AUXILIARY VESSELS AND/OR AIRCRAFT CARRIED: Several launches, HH-52 or HH-3F helicopter

AUXILIARY EQUIPMENT (pumps, hoses, etc.):

Several pumps >2000' of hose

DOCKING OR MOORING LIMITATIONS:

Twin Screw, bow thruster to aid docking

FIELD MAINTENANCE AND SUPPORT REQUIREMENTS FOR EXTENDED OPERATION:

None. 30-45 days without support.

COMMUNICATIONS AND NAVIGATION EQUIPMENT ON BOARD (range, frequency, etc.):

Complete and adequate for Alaskan operations

APPROXIMATE OPERATING COST: ~ $480/hr

COMPARATIVE RELIABILITY OR ADAPTABILITY FOR ARCTIC OPERATION:

fair - not ice-reinforced

NARRATIVE DESCRIPTION AND/OR COMMENTS:

SHIP TYPE/CLASS: Offshore Fishing Vessel (Bender)

SERVICE CATEGORY(S): Secondary transportation

STATUS: Operational

OWNER/OPERATOR: Private individuals

APPROXIMATE NUMBER AVAILABLE IN ALASKA: ~50

GEOGRAPHIC LOCATION(S): Widespread throughout Gulf of Alaska

DECK CAPACITY (area/weight): 50' - 60' x 22', >50,000#

HOLD CAPACITY (volume/weight): ~5,000 ft^3/200,000#

CARGO HANDLING FEATURES OR RESTRICTIONS: 5-10 ton winch on boom
(containerization, deck winches):

SPEED: MAXIMUM 10.5 kts STANDARD 9.5-10 kts

OPERATING RANGE: AT MAXIMUM SPEED AT STANDARD SPEED 2,000 - 3,000 mi

FUEL TYPE REQUIRED: Diesel

DIMENSIONS: DRAFT 12' LOA 90' BEAM 24'

STANDARD DISPLACEMENT: ~190 tons

NORMAL COMPLEMENT: 4

ADDITIONAL PERSONNEL SUPPORT CAPABILITY: 2-4

OPERATIONAL LIMITATIONS DUE TO ENVIRONMENT (ranges of weather and ice
conditions, minimum water depth, etc.):

Approximately 20 foot minimum depth. Not ice-reinforced.

SHIP TYPE/CLASS (contd): Offshore Fishing Vessel (Bender)

AUXILIARY VESSELS AND/OR AIRCRAFT CARRIED: Dunlop or Elliot life raft

AUXILIARY EQUIPMENT (pumps, hoses, etc.): Varies

DOCKING OR MOORING LIMITATIONS: None

FIELD MAINTENANCE AND SUPPORT REQUIREMENTS FOR EXTENDED OPERATION: None

COMMUNICATIONS AND NAVIGATION EQUIPMENT ON BOARD (range, frequency, etc.):

Loran A & C, Northern radios, depthfinders, radar, CB radios, VHF Single sideband

APPROXIMATE OPERATING COST:

COMPARATIVE RELIABILITY OR ADAPTABILITY FOR ARCTIC OPERATION: Poor

NARRATIVE DESCRIPTION AND/OR COMMENTS:

The Bender vessels are perhaps the most common single class of large fishing vessels found in Alaska. The most common usage is for shrimp trawling or crab fishing with strings of pots. Many have a stern ramp and powerful winches to facilitate dragging heavy loads aboard which could be useful for oil cleanup operations. Common ports for these vessels are Kodiak, Sand Point, Dutch Harbor, and ports in lower Cook Inlet and Prince William Sound.

APPENDIX A-3

LAND VEHICLES

VEHICLE TYPE/CLASS: Rolligon STD Model 8860 Hauler

SERVICE CATEGORY(S): Primary/secondary transportation

STATUS: Operational

OWNER/OPERATOR: Naval Petroleum Reserve Office, Point Barrow

NUMBER AVAILABLE IN ALASKA: At least two

GEOGRAPHICAL LOCATION(S): Point Barrow

PAYLOAD CAPACITY (volume/weight): 30,000# max.-normal operating <20,000#, cargo deck - 15' long x 7'-8' wide

CARGO HANDLING FEATURES OR RESTRICTIONS: No restrictions. Optional (hydrocrane, winches, etc.) equipment includes A-frame or articulated crane. 20,000# capacity front winch included.

OPERATING RANGE: LOADED -- EMPTY --

SPEED RANGE: Up to 24 mph

FUEL TYPE REQUIRED: Diesel

FUEL CONSUMPTION: --

WEIGHT: GROSS ∿45,000# EMPTY 15,500#

OPERATORS REQUIRED: One

SEATING CAPACITY: Up to 5 in cab

OPERATIONAL LIMITATIONS DUE TO TERRAIN AND WEATHER (slopes, surface features, rivers, etc.): Ground clearance at pivot - 23"
Max. forward gradeability - 60%
Max. side gradeability - 45%
Max. angle of approach - 50 degrees
Max. angle of departure - 80 degrees
Minimum turning radius - 50 feet
Will cross deep water at reduced payload

VEHICLE TYPE/CLASS (contd): Rolligon STD Model 8860 Hauler

GROUND PRESSURE: LOADED 3-4 psi EMPTY Approx. 1 psi

DRAWBAR PULL: 20-90% of Gross Vehicle Weight, depending on terrain

FIELD MAINTENANCE AND SUPPORT REQUIREMENTS FOR EXTENDED OPERATION:

Normal servicing

COMMUNICATIONS AND/OR NAVIGATION EQUIPMENT: None specified

OPERATING COST: --

COMPARATIVE RELIABILITY IN ARCTIC OPERATION (sensitivity to icing, extreme cold, etc.): Subject to mechanical breakdown because vehicle relatively new. Have been tested and operated in the Arctic. Optional equipment includes Arctic cab. Tires subject to puncture over sharp objects (normally not found in the Arctic).

SELF-STARTING: Yes. (Arctic starting equipment optional)

NARRATIVE DESCRIPTION AND/OR COMMENTS: The Rolligon is essentially a normal heavy equipment chassis riding on low pressure wide rubber tires. Models available have maximum payload capacities of 2, 5, 10 and 15 tons and are built by the Rolligon Corporation in Houston, Texas. These models are a considerably different version of the Rolligons built by Bechtel that were operated at Prudhoe Bay. All eight wheels are driven by a conventional drive shaft arrangement rather than friction wheels. The smaller models have performance characteristics similar to those above. The 10- and 15-ton models are not air transportable by HC-130 because the wheels make the overall width excessive.

VEHICLE TYPE/CLASS: SEV - Model 7380 Voyageur (Bell)

SERVICE CATEGORY(S): Primary/secondary transportation/working platform

STATUS: Operational

OWNER/OPERATOR: --

NUMBER AVAILABLE IN ALASKA: None at present

GEOGRAPHICAL LOCATION(S): --

PAYLOAD CAPACITY (volume/weight): up to ∿40,000 #

CARGO HANDLING FEATURES OR RESTRICTIONS: (hydrocrane, winches, etc.) Cargo deck 40' x 32'. Deck load limit 1000 #/ft^2. Can be equipped with articulated crane.

OPERATING RANGE: LOADED 9-10 hrs EMPTY > 10 hrs

SPEED RANGE: Up to 55 mph in calm water, < 30 mph over rough terrain

FUEL TYPE REQUIRED: JP-4 or JP-5, Capacity 2,400 gallons

FUEL CONSUMPTION: ∿200 gal/hr

WEIGHT: GROSS ∿88,000 # EMPTY ∿35,000 #

OPERATORS REQUIRED: 3- Commander, Navigator/Radio Operator, Mechanic/Handler

SEATING CAPACITY: Normal crew. Accomodations for 20 or more could be placed on cargo deck.

OPERATIONAL LIMITATIONS DUE TO TERRAIN AND WEATHER (slopes, surface features, rivers, etc.):

Slope limitation probably between 10 and 15%.

Freezing of water spray on the skirts and superstructure, freeze-down of the vehicle while parked, and icing of engine intakes and ducts may constitute serious operational hazards.

Cannot normally negotiate obstacles over 3-4 feet high and ditches over 10-feet wide.

Winter darkness would vitually preclude high speed travel over rough terrain.

Operable in waves to at least 6-feet high and winds to 50 mph.

Turning radius: Low speed - 75 feet, High speed - 1/2 mile.

VEHICLE TYPE/CLASS (contd): Voyaguer

GROUND PRESSURE: LOADED < 1 psi EMPTY < 1 psi

DRAWBAR PULL: Can be used for towing

FIELD MAINTENANCE AND SUPPORT REQUIREMENTS FOR EXTENDED OPERATION:

Considered to be extensive because the vehicle is not fully developed for Arctic operation.

COMMUNICATIONS AND/OR NAVIGATION EQUIPMENT: Not specified. HF, VHF, ADF, Beacon, Inertial (general) and NAVSAT receiver (transit satellite positioning) for naviagation, Radar and Gyrocompass recommended.*

*From a feasibility study by the Arctic Institute of North America for the office of Naval Research.

OPERATING COST: Not available

COMPARATIVE RELIABILITY IN ARCTIC OPERATION (sensitivity to icing, extreme cold, etc.):

Not fully proven. Darkness and icing could impose serious constraints on normal operational capability.

SELF-STARTING: Yes. Auxiliary starting units recommended for cold operations.

NARRATIVE DESCRIPTION AND/OR COMMENTS:

The Voyageur is manufactured by the Bell Aerospace Company. The Canadian Coast Guard has tested the machine for SAR buoy tending, logistic, and oil pollution missions in the St Lawrence River and on the Great Lakes. The Canadian Ministry of Transport has recently tested the Voyaguer on the Mackenzie River Delta and found it to perform satisfactorily over the relatively smooth terrain encountered. The skirt system is fabricated from a single-ply nylon material coated with Neoprene. Power is provided by two marine gas turbines which drive two 9-foot diameter, controlled pitch propellers (three bladed) and two 7-foot diameter, 12-bladed lift fans.

VEHICLE TYPE/CLASS: Canadair Flextrac FN 360 (tracked)

SERVICE CATEGORY(S): Primary or secondary transportation

STATUS: Operational

OWNER/OPERATOR: --

NUMBER AVAILABLE IN ALASKA: None

GEOGRAPHICAL LOCATION(S): --

PAYLOAD CAPACITY (volume/weight): 36,000

CARGO HANDLING FEATURES OR RESTRICTIONS: None
(hydrocrane, winches, etc.)

OPERATING RANGE: LOADED -- EMPTY --

SPEED RANGE: --

FUEL TYPE REQUIRED: Gasoline

FUEL CONSUMPTION: --

WEIGHT: GROSS 70,000# EMPTY 34,000#

OPERATORS REQUIRED: One

SEATING CAPACITY: <5

OPERATIONAL LIMITATIONS DUE TO TERRAIN AND WEATHER (slopes, surface features, rivers, etc.):

Up to 60% slope (up/down) and 40% slope (side hill)
Also 58" fording depth

VEHICLE TYPE/CLASS (contd): Canadair Flextrac FN360 tracked

GROUND PRESSURE: LOADED 3.9 psi EMPTY 1.9 psi

DRAWBAR PULL: --

FIELD MAINTENANCE AND SUPPORT REQUIREMENTS FOR EXTENDED OPERATION: Minimal

COMMUNICATIONS AND/OR NAVIGATION EQUIPMENT: None specified

OPERATING COST:

COMPARATIVE RELIABILITY IN ARCTIC OPERATION (sensitivity to icing, extreme cold, etc.): Unknown

SELF-STARTING: Yes

NARRATIVE DESCRIPTION AND/OR COMMENTS:

<u>VEHICLE TYPE/CLASS</u>: M-116 Tracked Cargo Carrier

SERVICE CATEGORY(S): Secondary transportation

STATUS: Operational

OWNER/OPERATOR: U.S. Army

NUMBER AVAILABLE IN ALASKA: Unknown

GEOGRAPHICAL LOCATION(S): Unknown

PAYLOAD CAPACITY (volume/weight): --

CARGO HANDLING FEATURES OR RESTRICTIONS: --
(hydrocrane, winches, etc.)

OPERATING RANGE: LOADED 300 mile EMPTY --

SPEED RANGE: Up to 37 mph on land, 4 mph on water

FUEL TYPE REQUIRED: Diesel

FUEL CONSUMPTION:

WEIGHT: GROSS EMPTY 7,880#

OPERATORS REQUIRED: One

SEATING CAPACITY: 13

OPERATIONAL LIMITATIONS DUE TO TERRAIN AND WEATHER (slopes, surface features, rivers, etc.): Hampered by deep, soft snow

VEHICLE TYPE/CLASS (contd): M-116 Tracked Carrier

GROUND PRESSURE: LOADED 1.9 psi EMPTY --

DRAWBAR PULL: --

FIELD MAINTENANCE AND SUPPORT REQUIREMENTS FOR EXTENDED OPERATION: Minimal

COMMUNICATIONS AND/OR NAVIGATION EQUIPMENT: --

OPERATING COST: --

COMPARATIVE RELIABILITY IN ARCTIC OPERATION (sensitivity to icing, extreme cold, etc.): Good

SELF-STARTING: Yes

NARRATIVE DESCRIPTION AND/OR COMMENTS:

The M-116 is a full-tracked amphibious carrier for personnel or cargo capable of operating in most arctic onshore terrain.

VEHICLE TYPE/CLASS: Bombadier MUSKEG Tracked Transporter

SERVICE CATEGORY(S): Primary or secondary transportation

STATUS: Operational

OWNER/OPERATOR: --

NUMBER AVAILABLE IN ALASKA: None

GEOGRAPHICAL LOCATION(S): --

PAYLOAD CAPACITY (volume/weight): Up to 30,000#

CARGO HANDLING FEATURES OR RESTRICTIONS: None
(hydrocrane, winches, etc.)

OPERATING RANGE: LOADED -- EMPTY --

SPEED RANGE: 15 miles per hour

FUEL TYPE REQUIRED: Diesel fuel

FUEL CONSUMPTION: Unknown

WEIGHT: GROSS 54,000# EMPTY 24,000#

OPERATORS REQUIRED: One

SEATING CAPACITY: <5

OPERATIONAL LIMITATIONS DUE TO TERRAIN AND WEATHER (slopes, surface features, rivers, etc.): Up to 75% slope (up/down) and up to 65% slope(side hill)--also has 52" fording depth(non-amphibious)

VEHICLE TYPE/CLASS (contd): Bombadier Transporter

GROUND PRESSURE: LOADED ∿3.9 psi EMPTY ∿1.7 psi

DRAWBAR PULL: --

FIELD MAINTENANCE AND SUPPORT REQUIREMENTS FOR EXTENDED OPERATION: None

COMMUNICATIONS AND/OR NAVIGATION EQUIPMENT: None specified

OPERATING COST: None

COMPARATIVE RELIABILITY IN ARCTIC OPERATION (sensitivity to icing, extreme cold, etc.): Unknown

SELF-STARTING: Yes

NARRATIVE DESCRIPTION AND/OR COMMENTS:

The Bombadier Tracked Transporter has been used by the Department of Indian Affairs (Canadian Government) in the Northwest Territories and Arctic Stations. Due to the high ground clearance and wide track it is a very capable snow vehicle.

VEHICLE TYPE/CLASS: Canadair Flextrac FN NORCAN 300 (wheeled)

SERVICE CATEGORY(S): Primary or secondary transportation

STATUS: Operational

OWNER/OPERATOR: --

NUMBER AVAILABLE IN ALASKA: None

GEOGRAPHICAL LOCATION(S): --

PAYLOAD CAPACITY (volume/weight): 30,000#

CARGO HANDLING FEATURES OR RESTRICTIONS: None
(hydrocrane, winches, etc.)

OPERATING RANGE: LOADED -- EMPTY --

SPEED RANGE: Up to 27 miles per hour

FUEL TYPE REQUIRED: Diesel fuel

FUEL CONSUMPTION:

WEIGHT: GROSS 57,600# EMPTY 27,600#

OPERATORS REQUIRED: One

SEATING CAPACITY: <5

OPERATIONAL LIMITATIONS DUE TO TERRAIN AND WEATHER (slopes, surface features, rivers, etc.):

Up to 60% slope (up/down) and 40% slope (side hill)
Non-amphibious

VEHICLE TYPE/CLASS (contd): Canadair Flextrac FN NORCAN 300 (wheeled)

GROUND PRESSURE: LOADED 5.5 psi EMPTY --

DRAWBAR PULL: --

FIELD MAINTENANCE AND SUPPORT REQUIREMENTS FOR EXTENDED OPERATION: Minimal

COMMUNICATIONS AND/OR NAVIGATION EQUIPMENT: None specified

OPERATING COST:

COMPARATIVE RELIABILITY IN ARCTIC OPERATION (sensitivity to icing, extreme cold, etc.): Unknown

SELF-STARTING: Yes

NARRATIVE DESCRIPTION AND/OR COMMENTS:

VEHICLE TYPE/CLASS: Bell SK-5 Surface Effect Vehicle

SERVICE CATEGORY(S): Secondary transportation, working platform

STATUS: Operational

OWNER/OPERATOR: U.S. Coast Guard

NUMBER AVAILABLE IN ALASKA: None

GEOGRAPHICAL LOCATION(S): --

PAYLOAD CAPACITY (volume/weight): up to 5000#

CARGO HANDLING FEATURES OR RESTRICTIONS: Very limited cargo deck area (hydrocrane, winches, etc.)

OPERATING RANGE: LOADED 300 nm EMPTY --

SPEED RANGE: up to 70 knots

FUEL TYPE REQUIRED: JP4/JP5

FUEL CONSUMPTION: 75 gallons per hour

WEIGHT: GROSS 20,000# EMPTY 11,500#

OPERATORS REQUIRED: 3

SEATING CAPACITY: 9

OPERATIONAL LIMITATIONS DUE TO TERRAIN AND WEATHER (slopes, surface features, rivers, etc.): Slopes over 17%, solid walls over 3.5 ft, ditches over 12 ft wide and 8 ft deep, are its limitations.

VEHICLE TYPE/CLASS (contd): Bell SK-5

GROUND PRESSURE: LOADED <1 psi EMPTY <1 psi

DRAWBAR PULL:

FIELD MAINTENANCE AND SUPPORT REQUIREMENTS FOR EXTENDED OPERATION: Probably extensive because craft is complex and not completely developed.

COMMUNICATIONS AND/OR NAVIGATION EQUIPMENT: Similar to Coast Guard aircraft. Ground avoidance radar highly desirable.

OPERATING COST: Unknown

COMPARATIVE RELIABILITY IN ARCTIC OPERATION (sensitivity to icing, extreme cold, etc.): Has been tested at Fort Greeley and Point Barrow, but reliability remains to be proven.

SELF-STARTING: Yes

NARRATIVE DESCRIPTION AND/OR COMMENTS:

The Bell SK-5 is the same basic design as the SR.N5 of the British Hovercraft Corporation. Commercial versions have been available since 1964. The craft used for Coast Guard evaluations were the same craft that the Army operated in Viet Nam. The SK-5 has considerable potential for improving operational capability in several Coast Guard mission areas.

VEHICLE TYPE/CLASS: Tucker SNO-CAT, 2700 Series

SERVICE CATEGORY(S): Secondary transportation

STATUS: Operational

OWNER/OPERATOR: --

NUMBER AVAILABLE IN ALASKA: None

GEOGRAPHICAL LOCATION(S): --

PAYLOAD CAPACITY (volume/weight): 2300#

CARGO HANDLING FEATURES OR RESTRICTIONS: None
(hydrocrane, winches, etc.)

OPERATING RANGE: LOADED ∿100 miles EMPTY

SPEED RANGE: <10 mph

FUEL TYPE REQUIRED: Gasoline or diesel (optional engines)

FUEL CONSUMPTION: ∿0.2 gallons per mile

WEIGHT: GROSS 9,900# - 10,200# EMPTY 7600# - 7900#

OPERATORS REQUIRED: One

SEATING CAPACITY: 6-8

OPERATIONAL LIMITATIONS DUE TO TERRAIN AND WEATHER (slopes, surface features, rivers, etc.): Not amphibians

VEHICLE TYPE/CLASS (contd): Tucker SNO-CAT

GROUND PRESSURE: LOADED <1.0 psi EMPTY ∿.5 psi

DRAWBAR PULL: --

FIELD MAINTENANCE AND SUPPORT REQUIREMENTS FOR EXTENDED OPERATION: Minimal

COMMUNICATIONS AND/OR NAVIGATION EQUIPMENT: None specified

OPERATING COST:

COMPARATIVE RELIABILITY IN ARCTIC OPERATION (sensitivity to icing, extreme cold, etc.): Unknown

SELF-STARTING: Yes

NARRATIVE DESCRIPTION AND/OR COMMENTS:

The SNO-CAT is specifically designed for operation in the snow. The vehicle is manufactured by the Tucker Corporation in Medford, Oregon. Many smaller models are available with similar performance characteristics. The combination of high ground clearance and track widths over 8 feet (total) permit the vehicles to readily traverse areas of deep and soft snow.

APPENDIX B

SHELTERS

Source: Reference Manual on Shelters
U.S. Army Natick Laboratories,
Natick, MA, January 1972

1. <u>Name of Shelter</u>: Tent, Arctic, 10-Man

2. <u>Type of Shelter</u>:

Non-Rigid
Pole-Supported

3. <u>Current Status</u>:

Standard

4. <u>Responsible Engineering Activity</u>:

U. S. Army Natick Laboratories

5. <u>Physical Characteristics</u>:

This is a six-sided, pyramidal tent fabricated of 8.5 oz. cotton, wind-resistant sateen. A stovepipe opening is located in one of the sides near the eave. Both a front and rear entrance is provided with a lacing flap arrangement to permit erection of tents in tandem. A fire resistant liner is provided to insulate the tent and prevent frost from falling on the occupants. Each side of the tent measures 8'9". It is 8'6" at the peak, with a wall height of 3'. The floor area is 200 sq.ft. and the complete tent weighs 76 pounds. The tent can be pitched by 6 men in 27 minutes and struck by 6 men in 18 minutes.

6. <u>Concept of Use</u>:

This is a special purpose tent designed to provide shelter for 10 men and their equipment under arctic conditions.

7. <u>Logistical Data</u>:

This is a Standard A item which maintains low usage due to its special purpose. The FSN for the Tent, Liner, Pins and Poles is 8340-262-3685 and the cost is $393.00. The preceding stock number is for reference purposes only. The item is stocked and initially issued by components as follows:

8340-262-3684	- TENT, arctic, 10 man, w/cover liner, w/o pins and poles	1 ea
8340-261-9749	- PIN, TENT, 9 in lg	28 ea
8340-188-8413	- POLE, TENT, w/hardware, w/o cleats	1 ea

8. <u>Remarks</u>:

Specifications and drawings are available for procurement by DPSC, Phila. All training and maintenance manuals are available for the item. A standard repair kit is available for field repair of the item. The item has been found suitable in cold climates.

1. Name of Shelter: Tent, Frame-Type, Insulated, Sectional, 16' x 16'

2. Type of Shelter:

Non-Rigid
Frame-Type

3. Current Status:

Standard

4. Responsible Engineering Activity:

U. S. Army Natick Laboratories

5. Physical Characteristics:

The shelter is a sectional, frame-supported tent composed of an insulated skin, wooden supporting frame, insulated plywood floor boxes, and insulated vestibules. The insulated skin consists of 1" thick fiberglas batting captured between two layers of vinyl-coated cotton duck. The shelter is 16' wide, 16' long and 8' high and can be expanded in multiples of 4'. The complete shelter weighs 2,252 pounds. Six men can erect the shelter in 45 minutes and strike the shelter in 30 minutes.

6. Concept of Use:

To be used as a general purpose tent in extreme cold climates. The shelter can be transported by vehicle or aircraft.

7. Logistical Data:

This is a Standard A item which is in stock at Army depots. The FSN for the tent is 8340-262-2399 and the cost is $1,481.00. The preceding stock number is for reference purposes only. The tent is stocked and initially issued by components as follows:

8340-182-0436 - ARCH, TENT FRAME	5 ea
8320-508-0600 - CONNECTOR-SWITCH	1 ea
8340-377-6609 - TENT SECTION, end	2 ea
8340-377-6611 - TENT SECTION, intermediate	2 ea
8340-377-6612 - VESTIBULE, TENT	1 ea

8. Remarks:

Specifications and drawings are available for procurement by DPSC, Phila. All training and maintenance manuals are available for the item. A standard repair kit is available for field repair of the item. The item has been found suitable in extreme cold climates.

1. Name of Shelter: SPEED Mobile Kitchen

2. Type of Shelter:

Rigid (honey-comb with foam)

3. Current Status:

Exploratory Development

4. Responsible Engineering Activity:

U. S. Army Natick Laboratories

5. Physical Characteristics:

The shelter is constructed of foam filled honey-comb sandwiched between aluminum sheets. The shelter is a non-expandable design with the food service equipment built in. The shelter is 7' high, 8' wide and 12' long. It is designed for use with the standard Dolly Set, loaded on a cargo vehicle, or aircraft lifted. It is completely self-contained with no other than normal logistical support of food, fuel and water.

6. Concept of Use:

Designed as a highly mobile kitchen to support company size units in preparation and serving of hot food.

7. Logistical Data:

Production cost estimates of the shelter only in quantities of 100 or more is $8,000.00

8. Remarks:

Work is presently in progress to finalize the concept formulations, the acceptance of which will allow for initiation of a development program.

1. Name of Shelter: Portable Outside Toilet (POT) - BARE BASE

2. Type of Shelter:

Rigid
Expandable

3. Current Status:

Development Stage

4. Responsible Engineering Activity:

U. S. Army Natick Laboratories

5. Physical Characteristics:

The construction of the shelter walls, roof and floor consists of preformed polyurethane foam epoxied between .040 inch 6061-T6 aluminum. The skeletal structure is of welded aluminum extrusions. Dimensions are 40-1/4" wide, 50-1/4" long and 50" high when collapsed and 40-1/4" wide, 50-1/4" long and 87-1/2" high when expanded. In collapsing, the top shelter half slides over and envolopes the bottom half. The shelter weighs 325 pounds empty and 525 pounds with equipment.

6. Concept of Use:

The Portable Outside Toilet is a component of U.S. Air Force Bare Base System. It is for use at remote sights. Only electrical power and fuel are required for operation. Four items will fit on a 463L pallet for air transport. The item requires 1 man-hour of effort to make it operational.

7. Logistical Data:

Item is currently in the development state. Estimated cost following type classification is $2,500.00 per unit.

8. Remarks:

None

1. Name of Shelter: ATCO Expandable Shelter

2. Type of Shelter:

Rigid
Expandable

3. Current Status:

Development Stage

4. Responsible Engineering Activity:

U. S. Army Natick Laboratories

5. Physical Characteristics:

The shelter is constructed of foam filled honey-comb sandwiched between aluminum sheets. When packed, the shelter is 13' wide, 9' long and 8' high. When expanded, the height and width remain the same with the length increasing to 21'. A skid/rail system has been built in and allows complete compatibility with the 463L cargo handling system. The shelter weighs 2,300 pounds and can be expanded without special tools in less than 20 minutes.

6. Concept of Use:

Designed as a highly mobile shelter which houses the integrated kitchen facility for the Air Force BARE BASE Group.

7. Logistical Data:

Six shelters were developed for the Air Force BARE BASE Program at a cost of $21,000.00 each. It is estimated that on larger procurements of the shelter, the cost can be reduced to $15,000.00 each. None of these shelters are in stock.

8. Remarks:

A Technical Data Package will be furnished NLABS at the completion of the contract. No special training is required for erection of this item. Maintenance problems and suitability of the item will be available after evaluation by the Air Force.

1. Name of Shelter: Arctic Shelter - T-5

2. Type of Shelter:

Rigid
Expandable

3. Current Status:

Standard

4. Responsible Engineering Activity:

U. S. Army Mobility Equipment Research & Development Center, Fort Belvoir, Virginia

5. Physical Characteristics:

Building size is 20' span x 48' length with length variable in 4 ft. increments. Weight of a 20' x 48' building is 12,130 pounds. Expedient sills are required as a foundation. Building material is steel and wood. Insulation is 2-1/2" thickness fiberglass. Net cube for 20' x 48' building is 957 ft^3.

6. Concept of Use:

Utilize this shelter for arctic troop housing, etc. in all climates. The building is to be rapidly erected, dismantled, and reassembled permitting complete re-use of all materials. Erection time is 65 man-hours for the 20' x 48' building.

7. Logistical Data:

Estimated Cost: $10,000.00.

8. Remarks:

Type Classification: Standard A, Item 2270, CETC, MTG 260, dated 6 September 1955. Military Specification is MIL-B-14199, FSN is 5410-292-9919.

1. Name of Shelter: Rigid Arch Type Shelter (Sable)

2. Type of Shelter:

Rigid
Expandable

3. Current Status:

Development Stage

4. Responsible Engineering Activity:

USA Cold Regions Research and Engineering Laboratory

5. Physical Characteristics:

16 ft wide, 8' high and any length. In multiples of 4 feet. Constructed from Raypan, a composite material having a matrix of glass cloth woven with ties of the same cloth. Raypan materials used in the arches. This material is impregnated with resin. It is light, strong, rigid and tough. Simmons #2 Roto-Lock used for connections between structural components.

6. Concept of Use:

Can be used anywhere. Evaluated in climatic hangar at Eglin Air Force Base. Five structures used on a classified project in Alaska.

7. Logistical Data:

Cost of tooling and moulds to produce a prototype is estimated at $25,000.00. In mass production, it would be competitive with the Jamesway. The Tooele, Utah Army Depot has five of these units.

8. Remarks:

Designed by USACRREL constructed by Raypan Development Co., Inc. 5600 - Pacific Bld., Huntington Park, California.

1. Name of Shelter: Redesigned Jamesway Shelter

2. Type of Shelter:

Non-Rigid
Frame-Type

3. Current Status:

Development Stage

4. Responsible Engineering Activity:

USA Cold Regions Research and Engineering Laboratory

5. Physical Characteristics:

Square aluminum tubes used for ribs and purlins. Insulation consists of inner and outer skins of elastomer coated nylon bonded to 3/4 inch of flexible urethane foam. Width is 16 ft in the form of an arch with a semi-circle of 8 ft radius. Length is flexible as the sections are 4 ft long. A 24 ft model was used for testing.

6. Concept of Use:

This model was constructed under an intra-service agreement with the U.S. Army Natick Laboratories for test and evaluation at USACRREL.

7. Logistical Data:

One of a kind developed at a cost of $25,000.00.

8. Remarks:

Designed by Natick Laboratories and procured by same. Floor panel packing boxes are 8' in length and weigh 534 pounds. Under pinning required to support structure. Vapor migration through joints caused some condensate drip in winter from ribs and purlins. Interior vestibule incorporated in design. Concept does not lend itself to economical mass production because of required hand welds.

1. Name of Shelter: Portable Personnel Housing Shelter (BARE BASE) (EXP)

2. Type of Shelter:

Rigid
Expandable

3. Current Status:

Development Stage

4. Responsible Engineering Activity:

Air Force Bare Base Group

5. Physical Characteristics:

This shelter combines a rigid box/shipping container, folding 3" foam panels sandwiched between paper (roof) and 1" foam panels with a fiberglas skin (ends). The shelter is packed in a rigid shipping container which measures 3' by 8' by 13' when ready for transport. When erected, the shelter measures 13' wide, 35' long and 8' high.

6. Concept of Use:

Developed as a personnel shelter to billet eleven troops in support of the Bare Base Task Force. The shelter can be transported by vehicle or aircraft.

7. Logistical Data:

A quantity of 300 shelters are being procured from Goodyear Aerospace at a cost of $9,500.00 each.

8. Remarks:

A Technical Data Package will be furnished the Air Force at the conclusion of the contract.

1. Name of Shelter: Expandable Shelter/Container (BARE BASE) (ES/C)

2. Type of Shelter:

Rigid
Expandable

3. Current Status:

Development Stage

4. Responsible Engineering Activity:

Air Force Bare Base Group

5. Physical Characteristics:

This shelter is constructed of aluminum and vinyl cell foam wall panels. When the shelter is folded for storage and shipment, it measures 8'4" by 9' by 13'. When the shelter is expanded, it measures 25' wide, 13' long and 8'4" high.

6. Concept of Use:

Designed for use as a portable and highly mobile kitchen, Latrine unit, electronic shop, etc. When folded for shipment, it can be transported by helicopter, cargo aircraft, truck or dolly set.

7. Logistical Data:

The Air Force is procuring a quantity of 200 shelters from the Electro Mechanical Corporation at a cost of $11,000.00 each.

8. Remarks:

A Technical Data Package will be furnished the Air Force at the conclusion of the contract.